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AN ANALYSIS OF THE EDUCATIONAL OBJECTIVES IN THE AREA OF INVENTORY MANAGEMENT FOR SUPPLY CORPS OFFICERS ATTENDING THE NAVAL POSTGRADUATE SCHOOL

By

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June 1988

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An Analysis of the Educational Objectives in the Area of Inventory Management for Supply Corps Officers Attending the Naval Postgraduate School

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from the

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June 1988

ABSTRACT

A Supply Corps officers' knowledge of inventory management principles serves as the keystone of his professional career development. This thesis is an analysis of the Naval Postgraduate School (NPS) course titled Inventory Management (MN3377) that is required to be taken by the majority of Supply Corps officers who attend NPS. The thesis traces the development of the text for the course, (Naval Supply Systems Command (NAVSUP) Publication 553, Inventory Management) and of the course itself. The thesis evaluates whether the text and course are presently meeting the needs of the Navy. Based on this evaluation, a recommendation is made to revise the emphasis and content of the course. A revised course outline and learning objectives are presented. Additionally, chapter 1 of NAVSUP Publication 553, entitled "Supply Systems Overview and Basic Inventory Management Concepts", was revised and expanded, and is included as a part of this thesis.

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I. INTRODUCTION

A. BACKGROUND

A majority of Supply Corps Officers attending the Naval Postgraduate School are required to enroll in a one quarter course titled Inventory Management (MN3377). Most students take the course in the fifth quarter of a six quarter Master's degree program. The course was developed in response to the direction of the Chief of the Supply Corps during a 1982 curricula review. This course is intended for Supply Corps officers pursuing degrees in all Administrative Sciences curricula except the Systems Inventory Management curriculum. The text used for this course is Naval Supply Systems Command Publication 553, Inventory Management. The sponsor for the course and publication is the Naval Supply Systems Command.

Both the Naval Postgraduate School faculty and NAVSUP personnel have found NAVSUP P-553 to be in need of substantial revision since its publication in 1984. NPS faculty members Alan McMasters and Thomas Moore decided that the MN3377 Inventory Management course could be significantly improved by rewriting and enhancing NAVSUP P-553. They further determined that this revision would provide for a number of challenging student thesis projects. Prior to initiating this revision process, the

NPS Administrative Science Curricular Officer, Commander John Jackson, requested that the entire course structure be examined. He had received a considerable amount of formal and informal feedback which suggested that the course itself may not be meeting the needs of student officers in the Supply Corps or of NAVSUP, as the sponsor of the course. In response to this, Commander John Jackson suggested that an initial thesis project should be done which investigated the educational needs of the students who will take MN3377 in the future.

B. THESIS OBJECTIVE

This thesis examines a number of questions concerning the Inventory Management course and the NAVSUP Publication 553. The thesis has four primary goals.

The first goal is to examine the development of the course and determine if it evolved in accordance with the original intent of the Chief of the Supply Corps. Secondly, the current course is evaluated for its applicability to the target audience and the current needs of the Supply Corps. This evaluation will determine what format for an inventory management course would best complement the existing curricula and courses. Based on the results of this analysis, recommendations are made regarding future course direction and content. A third goal is to survey the adequacy of the NAVSUP P-553 as the Navy's primary reference manual for Inventory Management

and as the primary text for MN3377. Finally, as an initial effort to improve NAVSUP P-553, Chapter 1 of the publication was rewritten and expanded.

C. PREVIEW

Chapter II provides the historical background for the development of the Inventory Management course. This history was obtained in personal interviews with several participants and from NAVSUP headquarters documentation. The MN3377 course, in its present format, is described in Chapter III. Chapter IV presents the results of a survey of MN3377 alumni and a comparative analysis which includes other Navy inventory management courses taught at the inventory control points and the Navy Supply Corps School. Chapter V compares the existing course structure with a recommended, revised outline and learning objectives for MN3377. Finally, Chapter VI contains a summary and makes recommendations concerning the future direction of the course and the NAVSUP P-553.

II. COURSE AND TEXTBOOK HISTORY

A. BACKGROUND

When Rear Admiral A. A. Giordano became the Chief of the Supply Corps, one of his goals was to reduce the number of Supply Corps Officers selected to pursue government sponsored graduate education at private and state universities and to send those students to the Naval Postgraduate School instead [Ref. 1]. He sought to achieve this goal for two reasons. First, he wanted to stem the loss he perceived was occurring in the late seventies and early eighties of postgraduate talent from the Supply Corps. Rear Admiral Giordano stated that Supply Corps Officers armed with advanced degrees awarded by prestigious civilian institutions found employment outside the military extremely lucrative [Ref. 1]. A high percentage of these officers were induced to separate from the Navy after completing their payback obligation or retire at the first opportunity. In short, the Supply Corps was not realizing an acceptable return on the expensive investment made when sponsoring Supply Corps Officers for graduate education at civilian universities. Rear Admiral Giordano discerned that Supply Corps Officers earning a Master of Science in Management at the Naval Postgraduate School would not be as marketable in the civilian sector, while at the same time

these graduates would provide the Supply Corps with the pool of postgraduate talent needed to adequately staff required subspecialty coded billets [Ref. 1].

Secondly, Rear Admiral Giordano wanted Naval Supply Systems Command (NAVSUP) input to be considered in the design of the curricula and courses in which Supply Corps Officers were enrolled. NAVSUP had no influence in determining the curriculum structure or course content administered by civilian institutions. However, as a sponsor or co-sponsor for several of the curricula offered by the Administrative Sciences Department at the Naval Postgraduate School, NAVSUP could exert a significant influence in both curriculum and course development.

At his first opportunity, Rear Admiral Giordano requested a change to an existing course offered by the Administrative Sciences Department entitled Material Logistics (MN3372) [Ref. 2:p. 1]. During a curricula review at which he presided in June 1982, he expressed dissatisfaction with several aspects of the existing course and asked that the material requirements determination segment of the course be improved and the textbook then being used be replaced [Ref. 2:p. 1]. He also directed that the course be identified as a requirement for all Supply Corps Officers enrolled at the Naval Postgraduate School.

Specifically, Rear Admiral Giordano asked that the mathematical models used by the Navy Inventory Control Points (ICPs) in the requirements determination process be taught [Ref. 2:p. 1]. He believed that all Supply Corps Officers should possess a firm understanding of the basics of requirements determination. To illustrate this assertion, Rear Admiral Giordano often used a simple analogy,

> Just as every Line Officer must understand the basics of navigation, every Supply Corps Officer must understand the principles of requirements determination. [Ref. 1]

With this stated philosophy as the driving force for change, action items were agreed upon between NAVSUP and the Naval Postgraduate School to accomplish the requested improvements [Ref. 2:p. 1].

B. COURSE AND TEXT DEVELOPMENT

The Administrative Sciences Curricular Officer at NPS, Commander R. B. Renner, was given the responsibility for revising the requirements determination segment of Material Logistics (MN3372), since he was then teaching the course, and for establishing the course as a requirement for all Supply Corps Officers. Commander J. H. Perry, in charge of NAVSUP's Operations and Inventory Analysis Staff Division (NAVSUP-04A; now NAVSUP-042), was directed to study alternatives for developing a graduate level textbook detailing the Navy's mathematical models and policies regarding requirements determination [Ref. 3:p. 1]. Rear

Admiral Giordano provided the following guidance regarding the development of the text:

1. Relate to the basics of requirements determination policy.
2. Use appendices to treat complexities of models and math.
3. Focus on Navy policies and procedures.
4. Address both provisioning and replenishment scenarios at wholesale and retail levels.
5. Use Navy case examples and Navy computer listings.
6. Include the impact of the requirements determination process on material budgeting, procurement, material and fund control. [Ref. 3:p. 1]

In September 1982, NAVSUP-04A requested that the Ships Parts Control Center (SPCC), the Aviation Supply Office (ASO), the Navy Fleet Material Support Office (FMSO), the Navy Supply Corps School (NSCS) and the Naval Postgraduate School (NPS) provide comments and recommendations regarding the development of a requirements determination text for use at NPS [Ref. 3:p. 1]. All respondents were thorough in replying and recommended expansion of the proposed coverage of requirements determination to include other topics so the text could be useful to other activities as well. By November 1982, NAVSUP had a broad range of Navy-unique inventory management topics for consideration. Prior to forwarding the recommendations from NPS, the Curricular Officer, Commander R. B. Renner, determined that the scope of the proposed revision was too extensive to include in the existing course, Material Logistics (MN3372). NPS

therefore decided to develop a separate course and use the evolving text on requirements determination as the basis for this course [Ref. 4]. NAVSUP disseminated the consolidated list of topics to the working levels of the various activities and scheduled a conference to take place at SPCC in December 1982 to discuss the issues in detail [Ref. 3:p. 1].

At the conference, attendees expressed individual activity interest in the developing text. The two Inventory Control Points (ICPs), SPCC and ASO, indicated an interest in using the text as supporting documentation for their respective ICP Academies. Further, the Navy Supply Corps School (NSCS), located in Athens, Georgia, was considering using the text for a course entitled Career Supply Management (CSM), also under development at the time. Even with separate command self-interest entering the process, the attendees reached a consensus regarding the slate of topics and produced a proposed text outline comprised of ten chapters (Appendix A.1). The range of topics covered a wide spectrum of inventory management subjects. Interestingly, requirements determination was not addressed until Chapter Five.

Shortly after the December 1982 conference, Commander J. H. Perry (NAVSUP-04A) consolidated the comments and prepared a point paper highlighting the assembled

recommendations to present to Rear Admiral Giordano. The recommendations were as follows:

1. The graduate level text on requirements determination should be expanded and tailored for use at both ICPs and the Navy Supply Corps School, as well as the Naval Postgraduate School.

2. The maintenance of the text should be a joint ICP responsibility. (The ICPs were requested to formally reply to this tasking).

3. A separate course should be established at NPS.

4. The text should be developed by a contractor with an estimated cost of $100,000.00. The text should be completed by November 1983. [Ref. 3:p. 2]

With additional direction and comment from the Chief of the Supply Corps, NAVSUP-04A refined the proposed procurement document for developing the text and forwarded the request up the NAVSUP chain of command for final approval.

While these efforts were underway, the commanding officer of SPCC expressed concern about the perishable nature of the material being considered for inclusion in the requirements determination text. Additionally, SPCC indicated that the developing text would not supplant existing references for the Mechanicsburg ICP Academy. In a letter detailing SPCC's response to NAVSUP's possible tasking of ICPs to maintain the publication, the commanding officer, Rear Admiral E. M. Kocher wrote,

> I am reluctant to commit SPCC resources to a task force for text maintenance. Periodic revisions should be accomplished by follow-on contract. [Ref. 5:p. 1]

He also stated,

> I see no specific ICP need for such a text. While it will be helpful to our professional logisticians, it will not replace the UICP orientation of the ICP Academy. [Ref. 5:p. 2]

After further consultation with Rear Admiral Giordano, Commodore C. R. Webb, Assistant Commander for Inventory and Systems Integrity (NAVSUP-00X), was charged with ensuring a properly documented Statement of Work (SOW) accompanied the procurement request for the proposed graduate level text. In a memorandum dated 19 January 1983, Commodore Webb forwarded a revised Statement of Work for Rear Admiral Giordano's approval and signature (Appendix A.2). Prior to final approval of the procurement package, additional justification for the use of a contractor was sought. Commodore Webb provided the justification in a memorandum dated 7 February 1983 and identified the necessity to

1. Acquire a clear, well written and organized graduate quality text,
2. Expedite the text development to meet a summer of 1983 deadline,
3. Hold steady NAVSUP's current workload. [Ref. 6:p. 1]

Equipped with this justification, Rear Admiral Giordano approved the Statement of Work and signed the procurement document. The contract was competitively let and awarded to CACI INC., a consulting firm whose staff is comprised of a number of retired Supply Corps Officers who possess significant ICP and stock point experience. Mr. E. Eaton, CACI's project manager for developing the textbook, stated the company's strategy for obtaining the contract was to

offer a bid of only $50,000.00, an amount CACI concluded would substantially undercut any competing firm's bid [Ref. 7]. Mr. Eaton further explained that CACI was confident significant cost savings could be realized during the research phase of the project because of their staff's considerable expertise in Navy supply operations, but also admitted that CACI's bid left little margin for error. [Ref. 7]

The textbook development process involved CACI representatives researching then existing Navy requirements determination procedures and policies on site at FMSO, SPCC, and ASO. After gathering the requisite data, CACI produced the proposed text incrementally. As the chapters, appendices, and cases were developed, CACI forwarded the proposed product to NAVSUP, with copies also provided to the ICPs, FMSO, and NPS for review and comment. NAVSUP-04A consolidated the various corrections and recommendations made by FMSO, SPCC, and ASO and forwarded the revisions to Rear Admiral Giordano for final review.

This iterative process took much longer than expected and the files are replete with memoranda from the various parties detailing the deficiencies in the proposed chapters. A June 1983 memorandum from Rear Admiral Giordano (NAVSUP-00) to Commander Perry (NAVSUP-04A) regarding the first submission of chapter 2 states, "Don't make your graduate level text so Pig-ish that it omits the

basic equation", and "I would be pleased to talk to the contractor". [Ref. 8:p. 1] Another NAVSUP-00 memorandum dated September 1983 regarding a revised set of chapters 1, 2, and 3, contains caustic comments such as, "Totally UNSAT....written by a committee of illiterates" [Ref. 9: p. 1].

The repetitive process of revision after revision was continued until the final product was delivered in May 1984. In the preface, Rear Admiral Giordano writes,

> The purpose of this book is to describe the basic requirements determination process within the Navy in a simple straightforward manner....The text is intended to serve as a key building block in any Navy logistician's training, a primer on requirements determination for ready reference and a common body of general information which should be understood by all Supply Corps Officers. [Ref. 10]

In the final paragraph to the preface, Rear Admiral Giordano, the prime catalyst for both the development of Inventory Management (MN3377), the course, and Inventory Management (NAVSUP P-553), the publication, again highlights his analogy of Line Officer and navigation to Supply Corps officer and requirements determination.

C. POSTSCRIPT TO COURSE AND TEXT DEVELOPMENT

Following the distribution of the NAVSUP P-553, criticism of the text came quickly. Significant defects in the publication which should have been identified early in the development phase were the lack of a table of contents and an index. Users of the manual seeking specific subject

material had to painstakingly scrutinize the text to locate the desired information. Two FMSO operations analysts, J. Mellenger and C. Bondi, developed a table of contents and an index for the NAVSUP P-553 on their own initiative and FMSO forwarded these improvements to SPCC, ASO, NAVSUP, and NSCS in September 1984. [Ref. 11] Interestingly, only NPS used the NAVSUP P-553 as the textbook for their respective courses. Commander G. H. Cook, developer of the Career Supply Management (CSM) course at the Navy Supply Corps School, stated the NAVSUP P-553 was too mired in the models to be of use to the CSM students [Ref. 12]. SPCC and ASO opted to use existing manuals for their respective ICP Academies.

The Naval Postgraduate School offered the initial Inventory Management (MN3377) course with the delivery of the NAVSUP P-553 in June 1984. For three years, the course and the text have continued to receive student criticism via Students Opinion Forms (SOFs) and memoranda addressed to the Administrative Sciences Curricular Officer. Chapter III will examine the current organization, content, and presentation of the Inventory Management (MN3377) course.

III. CURRENT INVENTORY MANAGEMENT (MN3377) OUTLINE

A. BACKGROUND

Inventory Management (MN3377) was initially offered during the summer quarter of 1984 and first advertised in the 1985 Naval Postgraduate School catalog. The course description has remained the same in all subsequent editions:

> The inventory management process of the Naval Supply Systems Command, with emphasis on the procedures for determining when and how much of a given item to order. Provisioning, wholesale and retail replenishment, and the supply budgetary process. A required course for all Supply Corps officers in Administrative Sciences curricula, except Systems Inventory Management.

Statistical Analysis for Management I (OS3105) is listed as the sole prerequisite for Inventory Management (MN3377).

The course has been presented eight times by three different instructors. The last five offerings were taught by Assistant Professor Thomas P. Moore. Although Inventory Management (MN3377) has evolved somewhat over the past four years, the primary focus has remained consistent with Admiral Giordano's original intent. Navy requirements determination policies and the mathematical computations used by the Navy's Inventory Control Points (ICPs) and stock points to arrive at replenishment and initial provisioning decisions still receive the primary emphasis of the course. Appendix A.3 details the latest course

outline (winter quarter 1988) and learning objectives. A detailed discussion of the existing course outline as presented in the 1988 winter quarter will now be presented.

B. PRESENT OUTLINE

Week one was devoted to the routine administration required at the onset of every Naval Postgraduate School course: i.e., personal introductions, course syllabus distribution, textbook description, and a discussion centered on the professor's expectations and grading philosophy. A brief history of the course and the textbook, Inventory Management (NAVSUP P-553), was presented with a necessary warning regarding the age of the publication and the absence of any substantial update since the manual was delivered by CACI to the Naval Supply Systems Command in 1984. A solicitation was made to students for volunteers to rewrite a chapter of NAVSUP P-553 as a thesis project.

The course objective was emphasized and the students were expected, as a result of instruction and study, to be able to discuss and understand the mathematics used by the Navy to budget for and manage inventories of consumables and repairables. Requirements determination policies for routine replenishment, initial provisioning and mission provisioning were differentiated. The development of current Department of Defense (DOD) inventory management policies was discussed and the wholesale, intermediate

retail and consumer levels of inventory were introduced. A detailed presentation of the Navy's logistics support structure was highlighted, from the Secretary of the Navy (SECNAV) down the chain of command to the individual operating units in the field. Various individual command responsibilities were introduced. A short description of the Defense Logistics Agency (DLA) and subordinate activities was given, but the central thrust of the introductory lectures centered on the Navy's logistics support organization.

Towards the end of the first week, the purpose, structure, advantages and disadvantages of holding and not holding inventories were methodically addressed. Decision variables such as the number and type of supply echelons, storage site location, order quantity, reorder point and stockage location were discussed in detail. Systems parameters, of inventory systems in general, and the Navy's inventory system in particular, were likewise presented. Administrative ordering costs, inventory holding costs, unit costs, annual demand and leadtime demand were defined. Numerous handouts that provide additional information and errata to Chapter One of Inventory Management (NAVSUP P-553) were distributed as study aides.

In the beginning of week two, measures of effectiveness (MOEs) and the diverse Department of Defense instructions issuing these supply performance targets were introduced.

The value, strengths and weaknesses of the assorted measures of effectiveness used by the Navy were further discussed. Definitions of supply material availability (SMA), average days delay (ADD), and average days delay for delayed requisitions (ADDDR) as wholesale measures of effectiveness were compared and contrasted with such retail performance standards as gross availability, net availability and average customer wait time (ACWT). The Military Standard Requisitioning and Issue Procedures (MILSTRIP) and the Uniform Material Movement and Issue Priority System (UMMIPS) were addressed to illustrate how average customer wait time targets, given a specific requisition priority, are integrated with mandated system-wide gross availability goals to determine how long a customer can expect to wait for an ordered secondary item. Finally, operational availability (A_0) was defined and described as being an important measure of effectiveness in gauging system wide performance. The impact of mean supply response time (MSRT) on operational availability was stressed in terms of weapons systems being available to commanders in the field at any given point in time.

Following the discussion of the measures of effectiveness, the elements of basic inventory theory were introduced. The Wilson economic order quantity (EOQ) model was derived with special attention given to the assumptions underlying the process. Total annual costs (TAC), annual

administrative ordering costs and annual holding costs were all defined as a function of reorder quantity. Minimizing the total annual cost was explained as the objective of the Wilson EOQ model. The mechanics of measuring the rate of change of this total annual cost with respect to the calculated economic order quantity were illustrated. The argument was advanced that total annual cost is minimized when annual administrative ordering costs equal annual inventory holding costs. The significant limitations of the Wilson EOQ model were systematically depicted and the groundwork was laid to account for the stochastic nature of demand (D) and leadtime demand (LTD).

At the end of week two, the concepts of reorder point (RL), inventory position and procurement leadtime (PCLT) were introduced. Time was taken to standardize variable notation for class purposes because within NAVSUP P-553 several different notational expressions are used for the same variable. For example, reorder point is alternatively referred to as R, RL and ROP. The concept of inventory position was introduced and a graph depicting inventory position as a function of time was displayed. Segments of the graph representing the EOQ, LTD, RL and the safety level (SL) were identified.

Week three was allotted to addressing the probabilistic nature of leadtime demand. A general review of the normal distribution function was presented because of its role in

determining the probability or risk of leadtime demand exceeding the reorder point quantity. The formula used by the Navy Inventory Control Points to calculate the accepted risk level for a given item of stock was then introduced. With the level of risk established for a specific item, the procedure for extracting the normal deviate value, T, from the normal tables to calculate the reorder level was illustrated. A graph of the normal distribution function was displayed and the areas of the graph representing the risk, reorder level, safety level and mean leadtime demand were identified. The point was stressed that, in reality, leadtime demand is discrete and not continuous, as the use of the normal distribution function would suggest. At this juncture, the Poisson probability distribution was presented. The mechanics of determining the smallest integer reorder point that satisfies the level of risk mandated by the ICPs were illustrated.

During week four, the internal workings of a Navy Inventory Control Point were described, demand forecasting discussed and the groundwork was laid for presenting the various wholesale replenishment models. Terms such as item manager (IM), material cognizance (COG), consumable items, field level repairables, depot level repairables (DLRs), end items, secondary items, mark codes, policy shippers and receivers were defined. The existing requisitioning procedures used by customers to order

consumables and DLRs were explained. Particular emphasis was given to the physical flow of DLRs. The importance of transaction item reports (TIRs) in providing the ICPs with system-wide visibility of wholesale stock was stressed.

The computer software used at Navy ICPs, Uniform Automated Data Processing System-Inventory Control Point (UADPS-ICP or UICP), was introduced and the major files and applications relating to demand forecasting were highlighted. The Master Data File (MDF), the Repairables Management File (RMF), the Planned Program Requirements File (PPR) and the Due-in/Due-out File (DDF) were described. Various UICP applications such as Requirements Processing (BO1), Transaction Item Reporting (BO4), Planned Requirements (BO2), and Cyclic Levels and Forecasting (DO1) were presented to set the stage for introducing the wholesale replenishment models.

The remainder of week four and all of weeks five, six, and seven were used to present the actual mathematical computations of the various wholesale replenishment models. Procedures for forecasting quarterly demand, the standard deviation of quarterly demand, procurement leadtime demand, the standard deviation of procurement leadtime demand, repair survival rates and item wearout rates from historical data were discussed. Leadtime demand, the variance of leadtime demand, DLR carcass returns, DLR turn-around times, the variance of DLR turnaround times, repair

cycle time and the repair process output rate were depicted as forecasted values derived from other forecasts. The concept of filtering the historical observations to guard against including aberrant data in future forecasts was explained. Methods for deriving averages and exponential smoothing techniques applied to historical and predicted data were developed with attention directed to the differing exponential smoothing weights (alpha values) assigned by the Ships Parts Control Center and the Aviation Supply Office. The impact of trend tests on the alpha value assigned by the ICPs was also explored. The mean absolute deviation (MAD) of demand and the process of using its predicted value to obtain an approximation of the standard deviation of demand was further discussed.

With the above terms and processes sharply defined, the step by step logic flow used in UICP to determine forecasts of demand and mean absolute deviations of demand was methodically presented for each consumable mark code. Calculations to derive predicted values for procurement leadtime, MADs of procurement leadtime, leadtime demand, the variance of leadtime demand, the reorder quantity and the reorder point were also presented for these mark codes. Examples of each calculation were presented in class and homework problems were assigned to reinforce the model presentations. The justification that was given for such an in-depth study of each mathematical computation was that

Navy Inventory Managers should possess a thorough understanding of how the models work in order to adequately evaluate the output of those models.

During week seven, the wholesale replenishment models for depot level repairables (DLRs) were discussed. Carcass return rates, repair survival rates, ready for issue regenerations, wear-out rates, in process times and all associated mean absolute deviations and error terms were defined. The logic flow used in UICP for determining the order quantity, induction quantity, and reorder point for DLRs at both ICPs was developed. A brief discussion regarding the purpose of the Statification application (B20) in determining SPCC budget requirements by material COG was presented and followed by a description of how the Program Data Expansion application (B21) is used to formulate ASO budget requests. At the end of week seven, a take-home exam was distributed with a one-week due date.

The wholesale provisioning process and the mathematical models used to budget for and to determine initial range and depth of spares to be procured were presented in week eight and part of week nine. The meanings and uses of integrated logistics support (ILS), logistics support analysis (LSA), level of repair analysis (LORA), logistics review group (LRG), hardware systems command (HSC), provisioning technical documentation (PTD), source, maintenance and recoverability codes (SM&R), best

replacement factors (BRF), mission essentiality codes (MEC), mission criticality codes (MCC) and item mission essentiality codes (IMEC) were all discussed in terms of wholesale provisioning decisions. The cost difference (COSDIF) model for computing a top line budget for initial spares procurement was presented. Time weighted average months program (TWAMP) and time weighted units short (TWUS) were defined. Stockage decisions for demand items, non-demand items, insurance items and numeric stockage objectives were discussed. The SPCC Variable Threshold Model (VTM), an approved alternative to the COSDIF model that the Navy uses to determine initial wholesale requirements, was described.

The remainder of week nine and all of week ten was allocated to describing the retail level provisioning and replenishment processes. A brief history of the Navy's Retail Inventory Management and Stockage Policy (RIMSTOP) was outlined and the Department of Defense directives that allow RIMSTOP objectives were discussed. The Economic Range Model (ERM) and the Variable Operating and Safety Level (VOSL) model, applications of the Uniform Automated Data Processing System-Stock Point (UADPS-SP) used by Navy stock points, were highlighted. A short overview of UADPS-SP was conducted and the internal workings of a stock point were lightly touched upon.

The retail provisioning process was given the most emphasis. Consumer allowance lists such as the Coordinated Shore Based Allowance List (COSBAL), the Coordinated Shipboard Allowance List (COSAL), the Shore Consolidated Allowance List (SHORECAL) and the Aviation Consolidated Allowance List (AVCAL) were discussed. The various mathematical models used by SPCC and ASO to determine range and depth cuts for item inclusion in the assorted allowance lists were also described. The logic flow for the Fleet Logistics Support Improvement Program (FLSIP) and the Modified Fleet Logistics Support Improvement Program (MOD-FLSIP) was methodically discussed. Likewise, the Allowance Requirements Register (ARR) calculations for AVCAL composition was addressed.

The methods used to construct load lists carried aboard Mobile Logistics Support Fleet (MLSF) ships and the tenders were the last topics presented in week ten. The Tender and Repair Ship Load List (TARSLL) and the Fleet Issue Load List (FILL) were introduced. The TARSLL Variable Protection Model and the FILL Math Model were described and examples of problems were worked in class to illustrate the two processes.

Week eleven was used for the presentation of group projects. The projects were assigned early in the quarter to give students the opportunity to learn specific aspects of inventory management not covered in class. Topics for

research were assigned to groups of five to six students. Term papers were prepared by the groups and project presentations were conducted during the last week of class. Petroleum fuels, DLA managed material, TRIDENT material, air launched missiles, and medical material were the subjects designated for research. At the end of week eleven, a take-home exam was distributed with a one-week due date. Material presented since the first test and topics covered during the project presentations were included in the final examination.

C. ACTUAL SCHEDULE DURING WINTER 1988

During the winter 1988 presentation of Inventory Managment (MN3377), the class fell behind the course outline during the presentation of the wholesale replenishment requirements determination models. Due to the complexities of the models, the unclear presentation of the models in the NAVSUP P-553, and the class inexperience in UICP application, Professor Moore was forced to slow the pace of instruction. As a result, the subject material scheduled to be presented in weeks ten and eleven was omitted.

IV. METHODOLOGY AND DATA ANALYSIS FOR COURSE EVALUATION

A. METHODOLOGY

This chapter will present the methodologies used to answer the primary thesis questions. The chapter attempts to determine whether the current Naval Postgraduate School course in inventory management (MN3377) meets the needs of the graduates and the Supply Corps given that only a single quarter is devoted to providing education in this area to non-inventory specialists. Secondly, this chapter will attempt to determine what inventory management topic areas are most important and should be taught in this course. Finally, the chapter provides an evaluation of whether the Naval Supply Systems Command Publication 553 is an adequate text for a graduate level course in Inventory Management. Three primary methods were used to obtain the data needed to answer these questions; a comprehensive survey of Naval Postgraduate School graduates, personal interviews, and a comparison of MN3377 to other key Supply Corps inventory management courses. Personal interviews with both past and present key Naval Supply Systems Command headquarters (NAVSUP) personnel, were conducted to determine the direction the course should take. From an historical perspective, the interviews with the individuals who made policy for the origination of the MN3377 course provided

data for comparison to how the course actually evolved. This data has been detailed in Chapters II and III.

The survey of former NPS students was designed to obtain feedback from these graduates concerning the MN3377 course, what subject areas should be covered in the course and on the NAVSUP P-553. Survey questions were designed for ease of quantitative analysis, but ample space was also provided for the survey respondent to make general comments regarding the course.

Finally, visits were made to Mechanicsburg, Pennsylvania and Philadelphia, Pennsylvania to determine the inventory management topics being taught in the Inventory Control Point Academies at the Ships Parts Control Center and the Aviation Supply Office. In addition, an interview was conducted with Commander Hardy Cook who developed and teaches the Career Supply Management course at the Navy Supply Corps School in Athens, Georgia. Comparison of MN3377 with these courses was not considered to be critical in making recommendations since the role of each of these other programs is to train rather than educate. However, some important insight can be gained as to what inventory management topics are considered to be most important to the Supply Corps.

B. THE SURVEY

In the survey of former NPS graduates, four areas were addressed. These areas included the NAVSUP P-553, the

present MN3377 course, recommended course topic areas, and the inventory management subject areas most often used on the job by the survey respondents. The survey questionnaire, presented in Appendix B, was designed so that the data and opinions could be compiled and analyzed in total and by curriculum group. The four primary curriculum groups who take MN3377 are:

1. 813 (Transportation Logistics Management)
2. 815 (Acquisition and Contract Management)
3. 827 (Material Logistics Support Management)
4. 837 (Financial Management)

The reason for breaking the results down by curriculum was to determine whether the course was meeting the needs of graduates in certain curricula and subsequent P-coded assignments.

Questionnaires were sent to 105 Supply Corps graduates of NPS who completed MN3377. This sample represented a majority of the graduates who had taken the course since its inception in late 1984. Sixty-nine responses were received, representing a 66 percent response rate. This response is considered to be a good representative, non-random, sample based on an original survey goal of a fifty percent response rate. Professor Nancy Roberts, an NPS Administrative Science faculty member, stated that fifty percent would be a good response for a survey of this type. Many of the survey responses contained lengthy written

comments indicating a high degree of interest in the survey project.

The first group of questions in the survey addressed the NAVSUP P-553. The goal of this series of questions was to ascertain whether the publication was appropriate for use as the text in NPS's MN3377. In addition, questions were asked that would indicate the degree to which the NAVSUP P-553 is used in specific Supply Corps billets held by graduates.

The first question simply asked the survey respondent to grade the clarity and readability of the NAVSUP P-553 on the following scale: Poor-Below Average-Average-Good-Excellent. Almost 70 percent evaluated the publication as below average or poor. Arranging the responses by curriculum did not indicate much variance from the total results. Figure 4.1 illustrates these results. The next two questions sought to obtain feedback on the content of the publication in terms of usefulness in the course and as a professional Supply Corps reference. The results of both these questions indicated the P-553 is between average and below average. These results can be found in Figures 4.2 and 4.3. Quite a few survey respondents used the general comments section to emphasize that they felt strongly that the NAVSUP P-553 was not appropriate for use as a text for the Inventory Management course and should be revised.

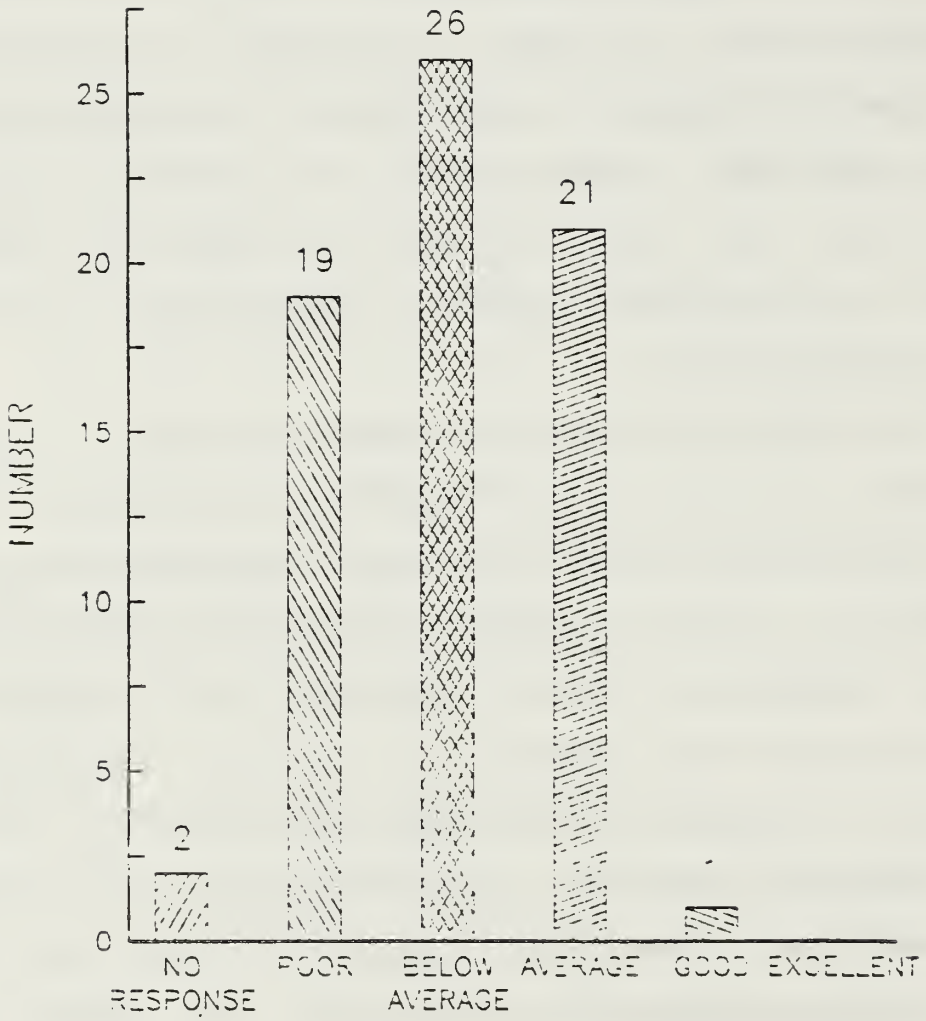

Figure 4.1 Graduates' Evaluation Of Clarity And Readability Of NAVSUP P-553

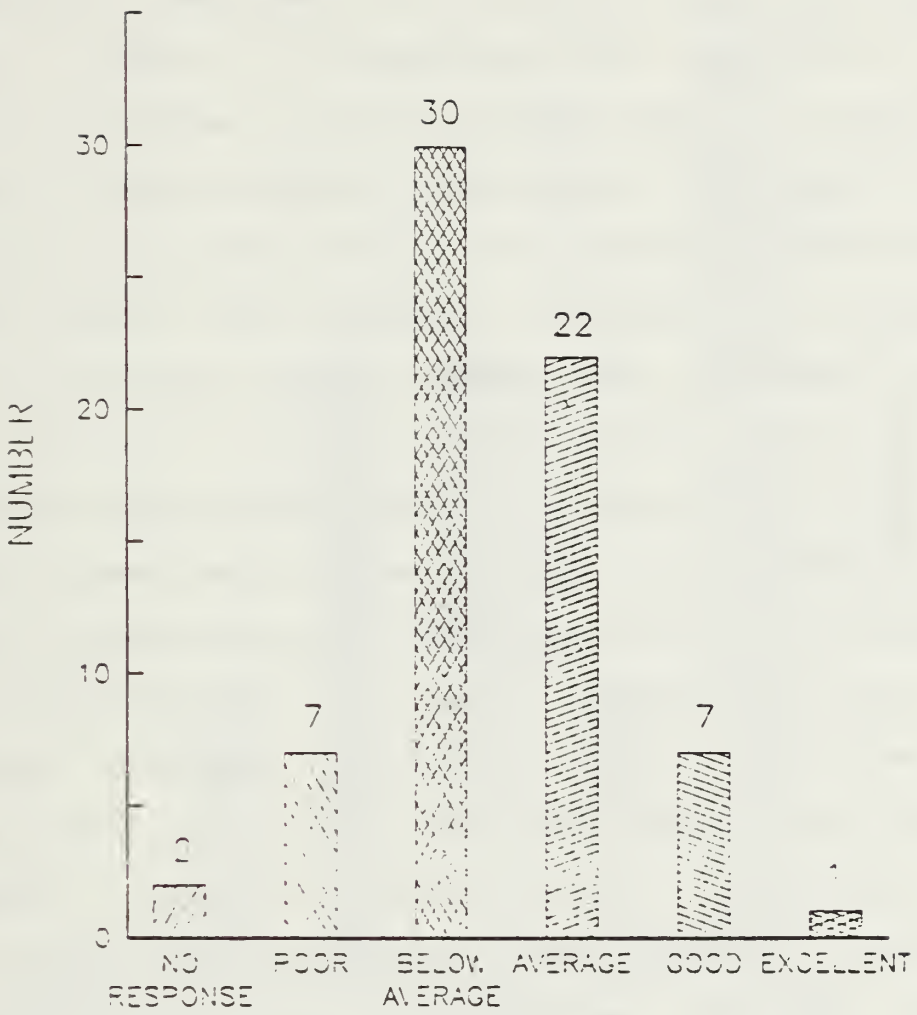

Figure 4.2 Graduates' Evaluation Of NAVSUP P-553 As The Text For Inventory Management (MN3377)

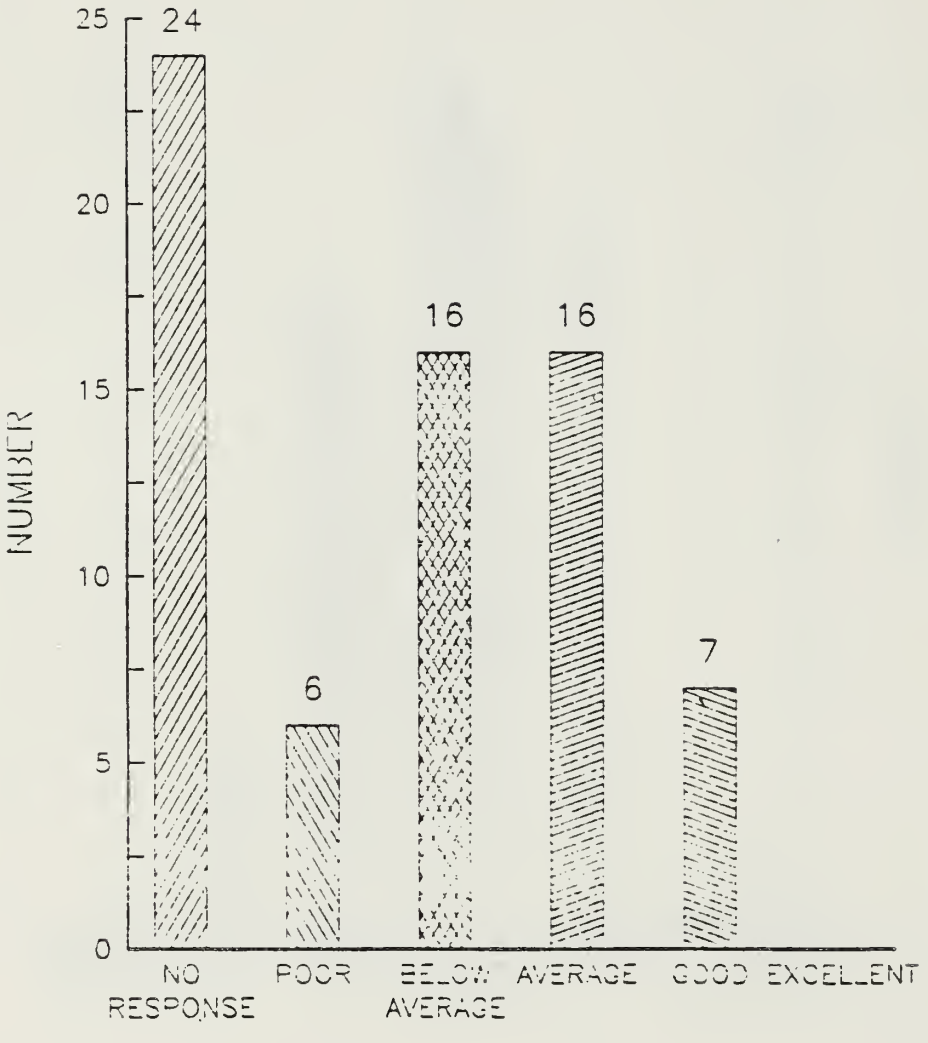

Figure 4.3 Graduates' Evaluation Of The Usefulness Of NAVSUP P-553 As A Professional Supply Corps Reference

The final part of the first series of questions attempted to determine the degree to which the NAVSUP P-553 is used by graduates in performing currently assigned duties. Figure 4.4 illustrates the responses to this question in terms of average annual usage. A significant number of the respondents (87 percent) indicated that they never use the publication in their jobs. Of the few that do use NAVSUP P-553, Figure 4.5 provides an interesting three dimensional analysis of the usage frequency per year by curriculum and chapter. Although the numbers of total graduates using NAVSUP P-553 is too small to gain any great insight, some trends can be observed. The personnel in the Material Logistics Support Management (827) curriculum use the publication with far greater frequency than the other curricula graduates. This would seem to make sense since these graduates, for the most part, are filling inventory management oriented, P-coded billets. The chapter used most often by all graduates was Chapter 3--Wholesale Replenishment Concepts and Policies. A few officers currently holding inventory related billets stated in the general comments section that they found the NAVSUP P-553 helpful on occasion, but many also commented that it was inaccurate or that sections were not current.

From this series of questions addressing the NAVSUP P-553 it is possible to draw conclusions about its usefulness in MN3377 and, on a limited basis, in the Supply Corps at

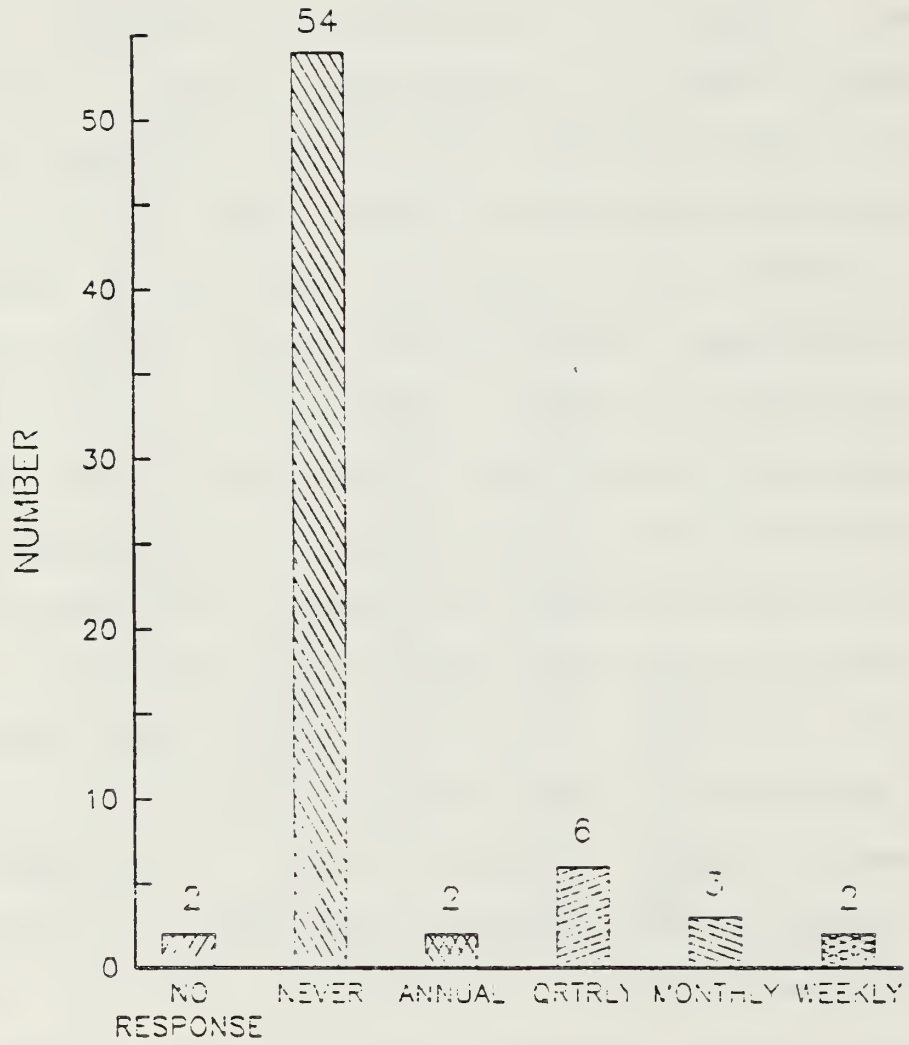

Figure 4.4 Graduates' Actual Use Of NAVSUP P-553 In Their Current Billet

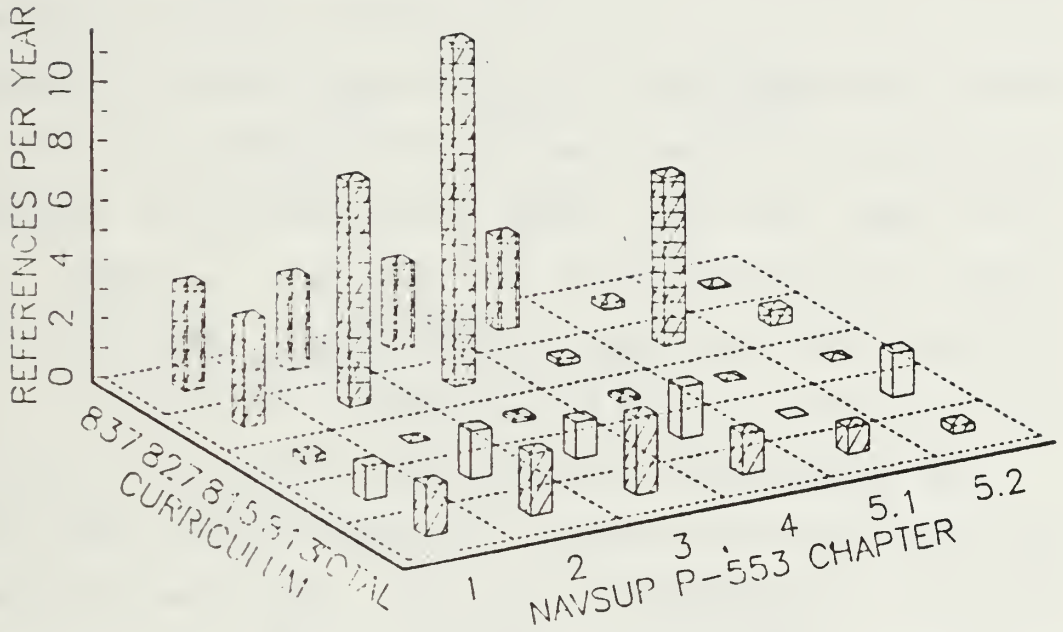

Figure 4.5 Average Annual Usage Of NAVSUP P-553 By NPS Graduates

large. The officers who responded to this survey, on the average, found the NAVSUP P-553 to be below average in clarity, content and usefulness as a graduate text. For a publication that was intended to be the Navy's primer on Inventory Management, it sees little use in the field. In fact, one officer in a key inventory/program management billet noted that his senior civilian inventory management specialist had never heard of the publication. As one final note, the Navy Supply Corps Newsletter frequently lists the publications of interest to Supply Corps officers along with their latest changes. NAVSUP P-553 is not to be found in this listing [Ref. 13:p. 48].

The next section of the survey attempted to obtain an evaluation of the Inventory Management course from former students. Two questions were posed. The first was whether the course met the student's needs and expectations. Secondly, did the course place too much emphasis on the math models? The responses to these questions indicate dissatisfaction with the course and the heavy emphasis on specific inventory math models. The results are graphically depicted in Figure 4.6. In addition, pre-survey, formal and informal comments made by current students to the Administrative Sciences Curricular Officer suggested that this course was not meeting student expectations.

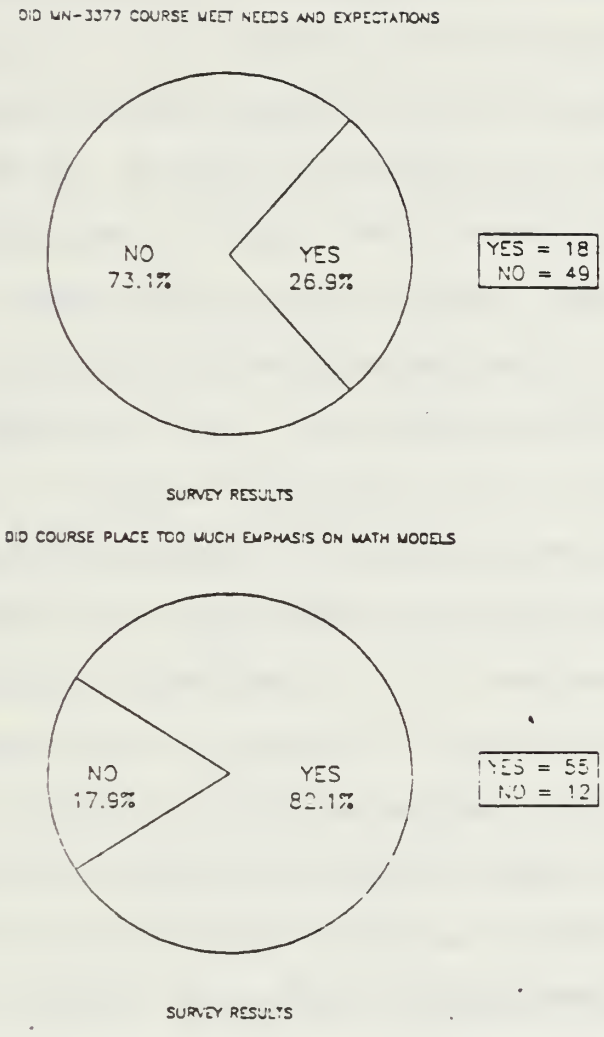

Figure 4.6 Graduates' Evaluation Of The MN3377 Course

The general comments from the graduates expressed a desire to move away from the in-depth analysis of the inventory models and towards a presentation of the inventory management process. As an example, one respondent stated that the course should concentrate more on how the Navy undertakes provisioning of new ships and weapons systems rather than a line by line examination of the computer math models for determining provisioning levels. Most of the Acquisition and Contract Management (815) and Financial Management (837) graduates concurred with this view. In contrast, many of the Material Logistics Support Management (827) graduates seemed to have a greater appreciation for some depth of understanding of the models themselves. It is important to emphasize that most of the graduates recognized the importance of receiving a solid foundation in the basics of inventory management theory and concepts, but felt that the various Navy inventory models were covered in too great a depth. A representative sampling of the survey general comments is provided in Appendix C.

The survey questions, up to this point, addressed what has been occurring in the course to date. The remainder of the survey sought to solicit input on what NPS graduates felt were the most important topics that should be taught in a one quarter inventory management course. Survey question number 5 presented a comprehensive list of 17

inventory management topic areas. The list of topics was developed based on current course subjects, topics suggested from various sources during thesis travel, and in consultation with Professors Moore and McMasters. The graduates surveyed were instructed to choose the ten topics they felt would be most valuable for inclusion in the course. Additionally, they ranked these choices from most to least important. Based on the graduate's survey responses to this question, the topics were given numerical weights depending on how high the graduates ranked them. For example, a topic rated number 1 was given a weight of 10, a topic rated number 2 was given a weight of 9, and so on. The seven topics not chosen by the respondents were assigned a weight of zero. The question totals were compiled using these weights. The averages over all respondents were then computed and are shown in Figure 4.7 and Table 4.1. The topics making the top of the list contain some similarities to the current course syllabus but it is evident that the respondents favored a move towards teaching how the inventory management system functions. The topics emphasizing concepts, processes and issues were ranked considerably higher than those concentrating on models. The following three topics were ranked well above the others:

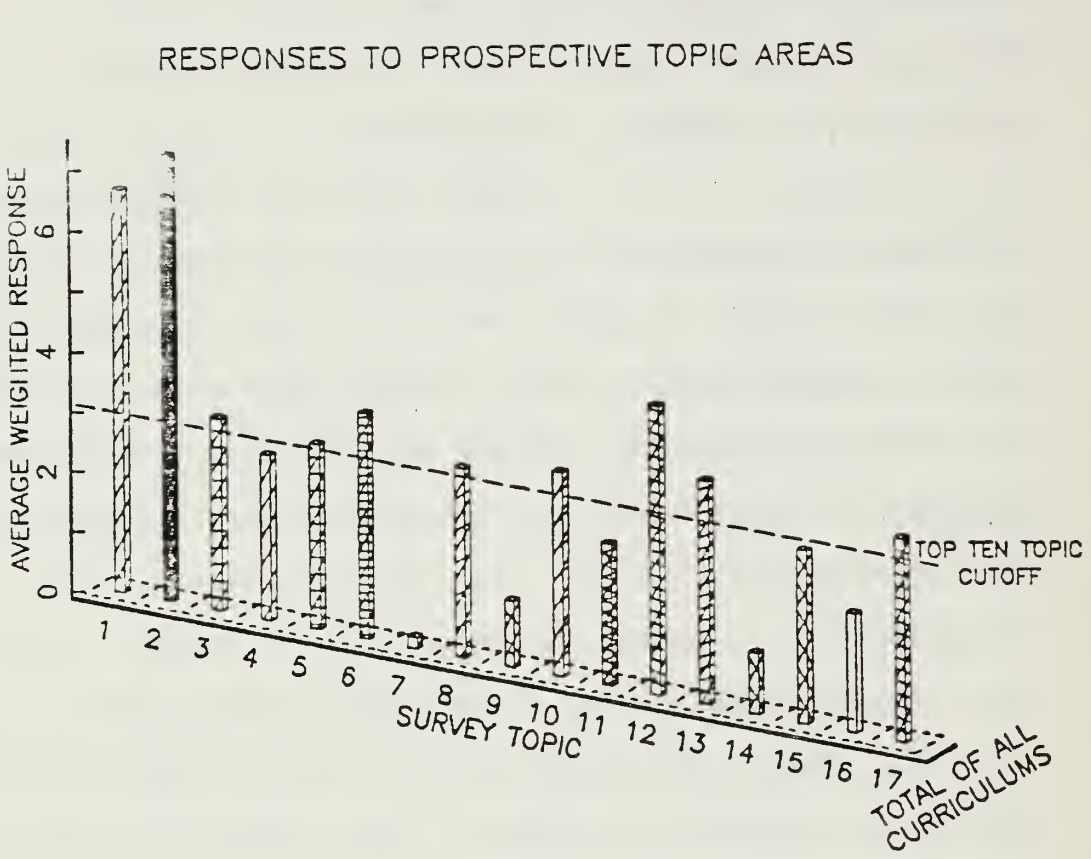

Figure 4.7 Graduates' Recommended Inventory Management Topic Areas For The MN3377 Course

TABLE 4.1 GRADUATES' RECOMMENDED INVENTORY MANAGEMENT TOPIC AREAS FOR THE MN3377 COURSE

RANK	TOPIC #	TOPIC DESCRIPTION
1	2	Basic Inventory Management Concepts
2	1	Overview Of The Supply & Material Distibution System
3	12	Current Inventory Management Problem Issues
4	6	Wholesale Replenishment Concepts And Policies
5	13	Wholesale Provisioning Process
6	10	Inventory Accuracy Methods
7	17	Material Budgeting
8	3	Allowance List Development
9	8	Retail Replenishment Concepts And Policies
10	5	Current And Future Inventory Management Developments
11	15	Overview Of Other Material Inventory Systems
12	4	Forecasting Models And Procedures
13	11	Inventory Management At The Hardware Systems Commands
14	16	Wholesale Repairables Management
15	9	SUADPS
16	14	Wholesale Provisioning Models
17	7	Disposal

1. Overview of the Supply and Material Distribution System
2. Basic Inventory Management Concepts
3. Current Inventory Management Problem Issues

The following three topics were rated much lower than most:

1. Shipboard Uniform Automated Data Processing System
2. Wholesale Provisioning Models
3. Disposal

The remaining topic areas did not exhibit a wide variance in ranking.

NPS graduates who have taken MN3377 are assigned to a wide variety of Supply Corps billets. Their assignments include sea duty, stock points, inventory control points, Naval air stations, and DLA billets. Due to this variety of jobs, there was some question as to the degree of agreement the respondents would exhibit regarding topic selection and ranking. A Kendall's coefficient of concordance test was conducted to test for agreement among the respondents' answers to question 5. The result was a coefficient of 0.26 which indicates a low level of agreement [Ref. 14:pp. 194-195]. This rather low measure of agreement is thought to be attributed to the wide variance of billets held by the respondents as discussed above.

There was also a measurable difference in the way graduates ranked the topics based on their curriculums. A Spearman's test for correlation was conducted to determine

the degree to which the four curricula groups exhibited agreement on the recommended inventory management topics [Ref. 14:pp. 194-195]. The correlations were computed for

TABLE 4.2 CORRELATION OF RECOMMENDED INVENTORY MANAGEMENT TOPIC AREAS BETWEEN PAIRS OF CURRICULA

Curricula Pair	Correlation
813 - 815	0.79
813 - 837	0.76
815 - 837	0.81
815 - 827	0.63
813 - 827	0.61
837 - 827	0.72

each of the possible curriculum pairs and are shown in Table 4.2. The correlation figures indicate a generally high degree of agreement between the curriculum groups, but of particular note is that the least correlation is found between the 827 curriculum and the other curricula. This statistic is understandable since the 827 curriculum graduates, for the most part, are assigned to inventory management related billets upon completion of their NPS studies while students in the 813, 815 and 837 curricula are not. Additionally, it was observed that certain subject areas were given a higher weight depending on the billet in which an individual was serving. For example, an officer stationed at the Naval Sea Systems Command

(NAVSEA) tended to give a higher ranking to the topic "Inventory Management at the Hardware Systems Commands".

The final survey question was designed to determine what inventory management knowledge areas were used most often by graduates in their various billets. This information could be used in conjunction with survey question 5 to indicate possible course subject areas. In survey question number 6, a detailed list of 25 inventory management knowledge areas was presented to the respondents and they were requested to indicate the annual frequency with which they needed or used knowledge of the subject. The results of this question are presented in Figure 4.8 and Table 4.3. Areas receiving high usage frequencies should be considered for coverage in the course. Again, detailed knowledge of the Navy inventory models was ranked lower in terms of usage in Supply Corps billets. There were a few topics ranked highly in this question that were not specifically identified by question 5. They include:

1. Inventory Management Measures of Effectiveness
2. Weapons System File (WSF) Structure, Use and Maintenance
3. Navy Industrial Fund Inventory Management Policies
4. DLA Inventory Management Policies and Procedures

Table 4.3 certainly provides a useful listing of the topics in ranked order, but the topic areas that received

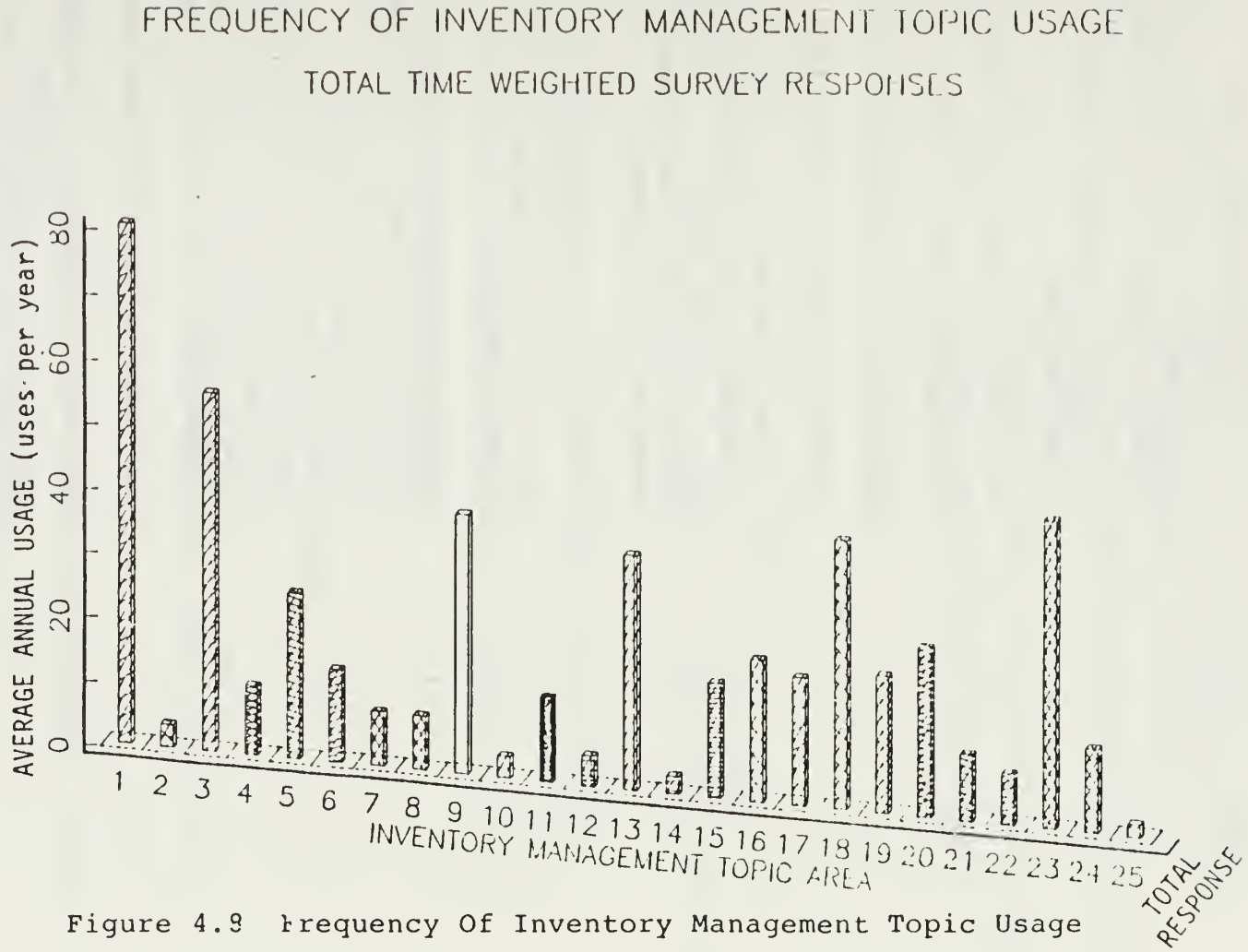

Figure 4.8 Frequency Of Inventory Management Topic Usage

TABLE 4.3 GRADUATES' USE OF INVENTORY MANAGEMENT TOPIC AREAS IN THEIR CURRENT BILLET (RANKED BY FREQUENCY OF USE)

RANK	TOPIC #	TOPIC DESCRIPTION
1	1	Organization Of The Navy Supply And Material Distribution System
2	3	Inventory Management Measures Of Effectiveness
3	23	Navy Stock Fund Procedures
4	9	UICP Policies And Procedures
5	18	Management Of Repairable Assets
6	13	UADPS-SP Programs And Files
7	5	Weapons System File (WSF) Structure, Use And Maintenance
8	20	Navy Industrial Fund Inventory Management Policies
9	16	Inventory Accuracy Methods
10	19	DLA Inventory Management Policies And Procedures
11	17	Inventory Management Policy And Procedures At The Systems Commands
12	15	SUADPS Files And Reports
13	6	Forecasting Models And Procedures
14	24	Budget Requirements Determination At The ICPs
15	11	Disposal Policy And Procedures
16	21	Wholesale Provisioning Process
17	4	COSAL/AVCAL Or Other Allowance List Development Procedures
18	8	SPLICE/SPAR Development
19	7	Demand Probability Distributions

RANK	TOPIC #	TOPIC DESCRIPTION
20	22	Wholesale Provisioning Requirements Determination Models
21	12	Retail Inventory Management And Stockage Policy (RIMSTOP)
22	10	Wholesale Requirements Determination Models
23	2	Economic Order Quantity (EOQ) Model
24	14	Retail Requirements Determination Models
25	25	STRAT/CARES

particularly high or low frequency of usage are of interest. Those topics cited as being used with the greatest frequency are:

1. Organization of the Navy Supply and Material Distribution System
2. Inventory Management Measures of Effectiveness
3. Navy Stock Fund Procedures
4. UICP Policy and Procedures
5. Management of Repairable Assets
6. UADPS-SP Programs and Files

Those topics cited as being used with particularly low frequency are:

1. Retail Inventory Management and Stockage Policy (RIMSTOP)
2. Wholesale Requirements Models
3. Economic Order Quantity (EOQ) Model

4. Retail Requirements Determination

5. STRAT/CARES

The survey response was enthusiastic in that a majority of graduates felt the course had the potential to be extremely valuable and expressed the desire that it be redesigned to achieve this potential.

The next two sections provide excerpts of interviews conducted during thesis research and a policy statement from the Commander, Naval Supply Systems Command regarding the MN3377 course.

C. PERSONAL INTERVIEWS

A series of personal interviews were conducted during the research phase of this thesis. The goal of these interviews was to solicit input from Supply Corps officers holding key billets regarding what the course content for MN3377 should be. Additionally, feedback was sought regarding the use of NAVSUP P-553 as the MN3377 text. Of the 20 officers interviewed at the two Inventory Control Points and the Naval Supply Systems Command, not one recommends that NPS should require non-Systems Inventory Management (819) students to enroll in a course that focuses primarily on the requirements determination models. The representative statements of these officers will now be presented.

Captain T. R. Nelson, head of the Operations Analysis and Material Requirements Division (NAVSUP-042), states that, "NPS should not be teaching a whole course on requirements determination to every Supply Corps officer". He advocates a more fundamental approach that, "emphasizes the basics of the provisioning and replenishment requirements determination process". In describing his experience with NAVSUP P-553, Captain Nelson states that, "I found the book almost worthless and would not recommend it as a textbook". [Ref. 15]

Commander J. E. Tufts, head of the Planning and Operations Analysis department of the Ships Parts Control Center (SPCC-041), states, "I do not think that a detailed presentation of the demand forecasting and requirements determination models to non-inventory management students is necessary. When questions arise concerning the effects of changing various model parameters, I seek the advice of my subordinates who are skilled analysts and require an in-depth knowledge of the models". [Ref. 16]

Commander J. S. Rountree, head of the Replenishment Budget Branch of the Naval Supply Systems Command (NAVSUP-0133) states that, "Students should learn what inventory managers do rather than memorize numerous UICP applications". An NPS graduate of the Financial Management (837) curriculum, Commander Rountree says that, "A detailed understanding of the mathematical inventory models is not

what the non-inventory management student needs". Finally, Commander Rountree observed that, "The NAVSUP P-553 text was written from an ICP perspective and assumes the reader has a great deal of knowledge about UICP. For the student, NAVSUP P-553 does not make teaching a big picture inventory management course easy." [Ref. 17]

Lieutenant Commander G. Canigiani, a 1987 NPS graduate of the Acquisition and Contract Management (815) curriculum and current head of the Contract Administration Division at the Ships Parts Control Center (SPCC-025), relates that, "I have no need whatsoever for a detailed understanding of the requirements determination process". He further states, "A general awareness of the requirements determination process is all that he requires to perform his present duties and that the ICP academy provides a five hour session for models and level setting overview that is sufficient for his needs". [Ref. 18]

The officers interviewed held a wide variety of billets and a majority of them were NPS graduates. The views expressed above illustrate the consensus of opinions regarding MN3377 and the NAVSUP P-553.

D. COMMANDER NAVAL SUPPLY SYSTEMS COMMAND POLICY STATEMENT

During April of 1988 the Commander, Naval Supply Systems Command, Rear Admiral E.K. Walker, traveled to NPS Monterey for a curricula review. As part of this process, one of the issues briefed to the Admiral was the future of

the Inventory Management (MN3377) course. The course history was discussed and the results of the survey were presented. At the conclusion of the briefing Admiral Walker's comments were sought. He felt that the original ideas of his predecessor, Admiral Giordano, were well intentioned but fell short of what was needed. Admiral Walker stated that he did not wish the course to be heavily weighted in favor of analyses of inventory models. His specific comment was, "I communicate to the operations analysis personnel what we need from inventory models. I pay the experts to do modeling." He felt that the officers pursuing the Operations Analysis or Systems Inventory Management degrees should continue to receive a heavy concentration of exposure to the inventory models, but the remainder of Supply Corps students should receive a basic introduction to the models. They should understand how the model "knobs" can be turned with varying results, and be aware of the limitations and weaknesses of the current models. The premise of Admiral Walker's policy statement was stated as follows, "This course should address the inventory management process from the broad management perspective." His final statement on this subject addressed the course's future. He stated, "My intuition is that all Supply Corps officers should take the course in a format revised to closely resemble the topics ranked highest in survey question number 5, but I would like

further investigation conducted to explore the impact of making the course optional."

E. OTHER NAVY INVENTORY MANAGEMENT COURSES - A COMPARATIVE VIEW

The final research area was a comparative examination of some other key courses on Navy inventory management. Aside from historical data gathering, the authors' thesis travel provided an excellent opportunity to interview the key personnel and coordinators of the other inventory management instruction in the Supply Corps. The three primary courses were reviewed. These were the ICP Academies at SPCC and ASO and the Career Supply Management course at the Navy Supply Corps School. The content of these courses was examined in order to determine which inventory management topics were stressed. These three programs are all targeted at mid- to high-level Supply Corps officers and civilian supply system managers. As such, they give a strong indication of what fields of study should be important to these managers.

The courses of instruction at the two ICP Academies are similar in content. The course outline is designed to introduce all mid-grade civilian and military managers to the workings of an ICP. These students are slated to assume a broad spectrum of management jobs. They will become managers of procurement personnel, budget analysts, expediters, and inventory managers. The Aviation Supply

Office ICP Academy offers instruction in the following general topic areas:

1. Weapon System Management
2. UICP Data Base
3. Requirements Determination
4. Procurement
5. Competition
6. Program Support ICP Functions
7. Retail Requirements
8. Requisitioning
9. General Miscellaneous Areas

The Ships Parts Control Center ICP Academy offers instruction in the following general topic areas:

1. SPCC Organization Overview
2. Provisioning/Configuration Management
3. Integrated Material Management
4. Requirements Determination
5. Procurement
6. Customer Support
7. Data Systems
8. Special Programs

The detailed ICP Academy schedules are found in Appendix D. Many of the topics covered are organic to the ICP alone, but the basic inventory management subjects are very comparable to the topics rated highly in the survey by NPS graduates. The amount of time spent analyzing specific

models is minimal. For SPCC, the time alloted to models and levels setting is roughly five hours out of a 72-hour schedule. At ASO, only three hours are reserved for Elements of Inventory Management/Replenishment Requirements Determination. A majority of the time spent in each of the ICP Academies is devoted to presenting overviews rather than specific details. This may partly be due to the possibly weak analytical backgrounds of the attendees.

The Career Supply Management (CSM) course is offered to mid-grade Supply Corps officers. The best way to describe the course is to use the description from the Career Supply Management Handbook, "CSM is not a technical training course intended to make the student an 'expert' or 'qualified practitioner of a skill'. Rather, CSM is a professional development course designed to enhance an officer's knowledge and provide him/her with a greater understanding and broader perspective for the entire logistics support system function. Successful completion of the course may best be measured in terms of its impact upon the officer's thoughts, approach and decisions as his/her Naval career continues." [Ref. 19:p. i]. The goals of this course certainly parallel what a graduate level education should accomplish and "closely" parallel the stated mission of NPS, "To conduct and direct the advanced education of commissioned officers, and to provide such other technical and professional instruction as may be

prescribed to meet the needs of the Naval Service." [Ref. 20:p.6].

The general subject areas covered in the CSM course include:

1. Weapons Systems Acquisition and Development Process
2. Supply and Material Distribution System
3. Civilian Personnel Management

Some of the important sub-areas addressed in the course include the PPBS, maintenance planning, provisioning, allowance lists, stock management, budgeting, and supply system measures of effectiveness (MOE's). The complete course schedule is included in Appendix D and contains many subjects that would not at all be appropriate for the NPS Inventory Management course. For example, several of the topics such as the PPBS cycle and procurement are covered, in detail, in other NPS courses.

The time alloted, in the CSM course, for inventory management is mainly limited to teaching how the system operates. Only a basic introduction to the elements of the various models is given. Commander Hardy Cook, who developed and teaches the CSM course, gave the following description of what they attempt to accomplish in teaching inventory management,

> We do a wonderful job of talking about safety levels and risk without belaboring the mathematical formulas. Our course stresses the importance of Planned Program Requirements, Numeric Stockage Objectives, four digit cog management, Best Replacement Factors, and other things that really matter rather than the math formulas. This

> is not to say that the math models are not important...it's just that there are only a very small handful of people in the entire supply system that need to know all the nuances." [Ref. 21]

The target audience in the CSM course is very similar to the Supply Corps students at NPS and the topics covered in CSM also correspond to the top rated subject areas of the survey. Due to recent funding constraints, the CSM course is scheduled to be discontinued in the summer of 1988. Since the students at both CSM and NPS are very similar, the MN3377 course will take on added importance once CSM is no longer offered.

F. SUMMARY

This chapter has described the research and data collection effort used in attempting to answer the thesis questions. The use of the survey, interviews of key personnel, policy statements from NAVSUP personnel and a comparison to other Navy inventory management courses provides a basis on which to draw conclusions and make recommendations. These will be presented in Chapters V and VI.

V. PROPOSED INVENTORY MANAGEMENT (MN3377) DESIGN

A. Proposed Course Learning Objective

An effective course is centered on a carefully researched overall course learning objective and is designed to meet the educational and professional needs of a sharply defined student population. Once the purpose of the course is validated and the student class composition are clearly identified, course designers can then weave subordinate learning objectives throughout the course outline to support the prime learning objective. As discussed in Chapters II and III, Rear Admiral Giordano's premise, that every Supply Corps Officer must understand the Navy-unique mathematical models for determining material requirements still remains the central theme of the existing Inventory Management (MN3377) course. However, the data collected from the interviews and surveys described in Chapter IV suggest that the Admiral's contention receives little support, both from those Supply Corps Officers who deal with the requirements determination models on a recurring basis and from those who have taken the course. Therefore, a revised overall course learning objective for the Inventory Management (MN3377) course is required to meet the needs of the Supply Corps as perceived

by the majority of those officers who were interviewed and surveyed.

Assuming that the course is retained as a requirement for Supply Corps Officers enrolled in the Transportation Logistics Management (813), Acquisition and Contract Management (815), Material Logistics Support Management (827) and Financial Management (837) curricula, the following overall course objective is offered as the foundation for an improved Inventory Management (MN3377) course:

> To prepare the students to make planning and control decisions within the Navy's supply system for acquiring, storing, issuing, financing, and verifying material inventories. As a result of instruction and study, the student will be able to understand and discuss the effects of changes in supply system decision variables and parameters upon the performance of the supply system.

A list of learning objectives designed to support the proposed overall course learning objective and the proposed course outline is detailed in Appendix E. A comparison of the proposed course outline with the existing course outline is discussed in the next section.

B. Proposed Course Outline

Designing the best course outline that provides students from the above curricula with the most important information about such a complicated subject as inventory management is a difficult task. Given the 40 to 45 hours of classroom time available, depending on the frequency of examinations and holidays, determining the specific topics

to include, and which to exclude is very difficult. Once the various potential topics are culled to fit within the allotted time, the instructor must then determine the depth with which each topic will be covered. Professional logisticians, academics and senior Supply Corps Officers can be found on both sides of an argument about the inclusion of a proposed topic and about the degree to which the topic should be covered. Based upon the research described in Chapter IV, the following proposed course outline is offered as a revision to the existing Inventory Management (MN3377) course outline.

The first three weeks of the proposed and existing course outlines differ very little in the topics covered and the emphasis placed on each topic. The Department of Defense and the Navy's integrated supply system are highlighted, the wholesale, retail, and consumer levels of inventory are described and fundamental inventory theory and terminology are introduced. Basic demand forecasting principles are discussed and an overview of the stochastic nature of demand and leadtime demand is explored. The Navy`s formula for calculating the acceptable risk of an item stockout is described and reorder levels and safety levels are defined. Week three ends with a discussion of the supply system's measures of effectiveness. These topics must be thoroughly covered as they are key to the understanding of the following material. Of those enrolled

in the class, only the Material Logistics Support Management (827) students are likely to have discussed this material in detail in a previous course (Material Logistics (MN3372)).

During week four the two course outlines begin to diverge substantially. Whereas the current course outline initiates a two-week presentation of the various wholesale replenishment requirements determination models (which took three weeks to complete during the winter 1988 offering of the course), the proposed course outline addresses the wholesale provisioning process, the wholesale replenishment process and the retail replenishment process (stock point operations) in successive weeks. As determined from the personal interviews and surveys, concepts and policies are emphasized more in the proposed outline than the actual mechanics of each mathematical model. By significantly reducing the time allotted to the coverage of the models, the proposed course outline frees approximately three weeks for the expanded coverage of topics lightly touched upon by the existing course and for the presentation of new material.

During week seven, the proposed course outline details the retail provisioning process and discusses the development of the various allowance lists, while the current course outline is only beginning to address wholesale provisioning. As before, the proposed course's

subordinate learning objectives emphasize process, concepts and policies instead of keynoting the mathematics of the models.

The proposed course outline presents material budgeting in week eight. The Navy Stock Fund (NSF), the Appropriated Purchase Account (APA), and budget projects are discussed. The Navy Stock Fund in particular, and material budgeting in general, are topics highly ranked in Tables 4.1 and 4.2 by the surveyed officers as subject matter that should receive coverage in the course. In the current course outline, budgeting and the Navy Stock Fund are not addressed until the last week, and in the last offering of the course, this area was not discussed due to the time consumed by the models and the in-class presentation of assigned group projects.

Inventory accuracy is covered in week nine of the proposed course outline. This topic is not discussed at all in the current course outline and the subject is ranked sixth in importance by the surveyed officers. The significance of file accuracy to forecasted demand calculations is stressed and ICP techniques used to reconcile their records with the Transaction Item Reports (TIR) sent by the numerous TIR activities are described. Further, physical inventory quality assurance programs are given coverage. Just-In-Time (JIT) inventory practices are also discussed. A one hour slot is reserved for a guest

lecturer to address current inventory accuracy topics; possible candidates for such a presentation can be solicited from the Systems Integrity Division at the Naval Supply Center Oakland.

Current inventory management issues are discussed in week ten of the proposed course. Suggested topics include recent GAO, DOD and Navy audit findings and recommendations, SPLICE and SPAR development, NAVSUP systems integrity problems and initiatives and alternative inventory management systems. These topics can be addressed either by group projects or by guest lecturers.

In summary, the major difference between the proposed and existing course outlines is the emphasis placed on the mathematics underlying the various wholesale and retail replenishment and provisioning models. The information gleaned from the research for this thesis suggests that alumni from MN3377 did not require a detailed understanding of the various models to perform their duties in follow-on assignments. Even 60% of the surveyed Material Logistics Support (827) students, one of whom is currently a weapons system manager at ASO, indicate they only require an understanding of basic inventory theory to perform assigned duties.

VI. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A. SUMMARY

Since June 1984, all NPS Supply Corps Officers enrolled in an Administrative Sciences curriculum other than Systems Inventory Management (819) have been required to enroll in Inventory Management (MN3377). This course focuses primarily on the mathematics of the wholesale and retail requirements determination models used by the Navy's ICPs and stock points. Student criticism of the course and the NAVSUP publication that serves as the course's textbook has been given to the professors that teach the course and to the Administrative Sciences Curricular Officer.

Commander John Jackson, the current Administrative Sciences Curricular Officer, informally surveyed the students who completed the summer 1987 offering of the course and decided a complete course review was required. At the same time, Professors Alan McMasters and Thomas Moore were seeking students who were interested in rewriting chapters of the NAVSUP P-553 for thesis projects. Combining these two projects, a thesis was developed to accomplish four goals: to determine if the Inventory Management (MN3377) course developed according to the original intent of the course, to determine if the current course meets the needs of the Supply Corps and the

educational and professional needs of the students who are compelled to enroll in the course, to determine the effectiveness of the NAVSUP P-553 as a graduate level text and to improve Chapter 1 of the NAVSUP P-553.

To gather the required data, a review of NPS, NAVSUP, and SPCC's files and records was conducted. Thirty-five Supply Corps Officers, civilian operations analysts, and professors were interviewed. A survey was designed and distributed to 105 NPS graduates who had completed the course. Finally, other Navy inventory management courses were compared with the NPS course. The data was quantified when possible, analyzed, and conclusions were drawn regarding the effectiveness of the Inventory Management (MN3377) course and the NAVSUP P-553. An improved course outline with supporting learning objectives was developed and is offered as Appendix E. Chapter 1 of the NAVSUP P-553 was revised and is offered as Appendix F.

B. CONCLUSIONS

The first goal of this thesis was to determine if the Inventory Management (MN3377) course developed as the originators of the course intended. The course, as presently structured, still focuses primarily on the material requirements determination models used by the Navy and this emphasis is exactly what Rear Admiral Giordano originally mandated.

The second goal of this thesis was to ascertain whether or not the Inventory Management (MN3377) course, taught by the Administrative Sciences Department at NPS, best meets the current needs of the Supply Corps, and the professional and educational needs of the students. Based on the data gathered from the surveys and personal interviews, Inventory Management (MN3377), in its present form, does not best serve the current needs of the Supply Corps or the students who are required to enroll in the course. The Supply Corps and the non-Systems Inventory Management (819) students can better be served if the approximately 28 hours of classroom time currently used to present the Navy-unique requirements determination models are reduced significantly and allotted to discuss other important aspects of inventory management.

The third goal of this thesis was to determine whether or not the NAVSUP P-553 is an adequate primary text for an inventory management course designed for non-Systems Inventory Management (819) students. Because chapters of this textbook were written by different authors, delivered incrementally and not reviewed by professional educators, this publication suffers from notational inconsistencies and poor subject matter coordination. Without a comprehensive revision and updating of the text, NAVSUP P-553 is not considered appropriate for use as a graduate

level textbook for an inventory management course designed for non-Systems Inventory Management (819) students.

The fourth goal of this thesis was to improve Chapter 1 of the NAVSUP P-553 with the underlying purpose of making the manual easier to read and more useful to non-Systems Inventory Management (819) students. The introductory chapter was expanded to include a wider coverage of the Defense Logistics Agency (DLA) and a more in-depth presentation of the Navy supply system's measures of effectiveness. The revision of the other chapters of NAVSUP P-553 is considered a worthwhile endeavor and the project should continue.

C. RECOMMENDATIONS

Inventory Management (MN3377) should be restructured and taught from more of a management perspective than is presently done. A modified course outline and learning objectives (Appendix E), incorporating topics most requested by the surveyed Supply Corps Officers, is offered as a baseline for future course development.

Unless Inventory Management (MN3377) is redesigned to better meet the educational and professional needs of the students who are currently required to enroll in the course, the course should be established as an elective. However, if the course is revised and taught form more of a management perspective, the course should remain a requirement for all Supply Corps Officers enrolled in an

Administrative Sciences curriculum other than Systems Inventory Management (819).

As Inventory Management (MN3377) was created solely at the request of the Naval Supply Systems Command, NAVSUP should provide NPS clear Guidance detailing what subject material should be included in the course. NAVSUP-042 should annually validate the content of the course. As part of the review process, NAVSUP-042 should solicit and receive input from the various NAVSUP departments regarding course content.

Inventory Management (MN3377) instructors should attend the SPCC and ASO ICP Academies to gain a better understanding of what Navy Inventory Managers actually do. The instructors should also attend the annual NAVSUP sponsored Retail Inventory Management Workshop to stay abreast of current retail inventory issues.

The NPS Administrative Sciences Department should be placed on the distribution list for DOD, DLA, SECNAV, OPNAV, NAVSUP, SPCC, ASO, FMSO, NSC Norfolk, and NSC Oakland directives and instructions with a Standard Subject Identification Code (SSIC) in the 4000 (Logistics) and 7000 (Financial) series. A current library of these instructions should be maintained in Ingersoll Hall for staff and students use.

Inventory Management (NAVSUP P-553) should be rewritten and updated under the direction of Professors Alan

McMasters and Thomas Moore if the manual is to continue as the text for the Inventory Management (MN3377) course. NAVSUP should provide funding to NPS for the revision of NAVSUP P-553.

APPENDIX A

A.1 PROPOSED TEXT OUTLINE

Chapter One The Role of Logistics in Meeting National Security Objectives

- Navy force levels
- Readiness and sustainability
- Readiness reporting systems
- Reliability, maintainability, and supportability
- Operational availability and the impact of logistics delay time
- Readiness reporting and performance measurement

Chapter Two The Integrated Logistics Support Process

- ILS defined
- Reasons for ILS
- Principal elements
- Related elements
- Weapons System ILS review process
- Reasons for review
- Defense Systems Acquisition Review Council (DSARC)
- Navy Systems Acquisition Review Council (NSARC)
- Acquisition Review Board (ARB)
- Logistics Review Group (LRG)
- Operational Evaluation (OPEVAL) process
- Planning and acquiring ILS
- Design support interface considerations
- Establishment of logistics development data
- Logistics support analysis
- Life cycle costing/role of shortages
- ILS plan
- Role of NAVSUP and the ICPs in weapons system program management support throughout the life cycle of an equipment
    - Prior to initial Fleet introduction of an equipment
    - Weapons system program support after Fleet introduction

Chapter Three An Overview of the Supply and Material Distribution System

- Functions common to all supply/distribution system
- Wiring diagram and brief description of key organizations in the Navy/DOD/National Supply System and their roles
- Brief historical review of the National Supply System
- Key DOD policies governing the supply system
- Integrated material management
- RIMSTOP
- Discussion of wholesale/retail stocks
- General Services Administration
- Defense Logistics Agency
- Defense Supply Centers
- Item management role
- Distribution depots and Navy specialized support points
- DLSC, DCAS, DPDS, DIPEC, etc.,

Chapter Four Basic Inventory Management Concepts

- Reasons for maintaining an inventory
- POS vs war reserve requirements
- RIMSTOP Three - Echelon Inventory System
- Levels of inventory vs levels of maintenance
- Role of the program support ICP
- Role of the wholesale Inventory Manager
- Role of the retail Inventory Manager
- Decentralized management
    - Set own levels
    - Pull material
    - Control allocated funds
    - Inventory accounting
    - Demand information
    - Stock policies
    - Shop Store/Ready Supply Store/SERVMARTS
    - UADPS-SP
    - Overview of major operating characteristics

Chapter Five Provisioning Concepts and Policies

- Maintenance Plan
    - SM&R codes
    - Forecasting failure rates
- Weapons System Planning data
- Wholesale requirements
    - Demand based
    - Non-demand based
    - Insurance terms
    - Numerical Stockage Objective (NSO) items
- Retail Requirements
    - Allowance and load lists
    - Maintenance Assist Modules (MAMS)
    - Installation and checkout spares
    - Other retail requirements
- Initial requirements determination
    - J-14 Optimization
    - Retail requirements development
    - Wholesale requirements development
- Manual initial requirements determination
    - Retail requirements development
    - Wholesale requirements development

Chapter Six Wholesale Replenishment Concepts and Policies

- Planned program requirements
- Demand recording and TIR
- Cyclic levels and forecasting
    - Validation filtering of demand/TIR observations
    - Forecasting (demand, leadtime, turn-around-time, etc.,)
    - Wholesale requirements development (reorder level & EOQ)
        (a) Role of CARES (maximize effectivity within available funding)
        (b) Buy/repair decisions
    - Activity stocking decisions

- Supply Demand Review
    - Requirements
        - Levels derived requirements (reorder level & EOQ)
        - Fixed requirements (backorders, referrals, PPRs, etc)
    - Assets
        - Consumable vs repairable
        - TIR Reporting activity assets only
- Disposal determination/retention stocks
- Manual review of SDR recommendations
- Procurement controls/impacts
    - SDR review thresholds
    - Procurement Review Boards
    - OPTARs/TRACKTARs
    - Fund Board - Funding execution policy
    - Competitive vs sole source procurements (including breakout program)

Chapter Seven Retail Replenishment Concepts and Policies

- Concepts
    - Demand-based/non-demand based
    - Rotatable/attrition authorizations
- Demand Recording
- Cyclic Levels and Forecasting
    - VOSL
    - Non-VOSL
- Replenishment Review processing
- Material excessing
- Stock point analyzer
- Management controls and performance analysis

Chapter Eight Repairables

- The repair decision
- Retrograde cycle concepts
- Carcass return dates/carcass tracking
- Wholesale repairables
  requirements determination

- Retail repairables
  requirements determination

Chapter Nine Material Budgeting

- Stratification
- The Navy Stock Fund
    - What it is
    - Why it exists
    - How large it is
    - How it works
    - Some basic principles
- Budget Cycles
    - Comparison of APA and Stock Fund procedures
    - Budget submission, review, and approval process
- Stock funding depot level repairables
    - Advantages
    - Pricing mechanisms
    - Developing customer budgets
- Budget execution
- Account and billing for material
    - Brief overview of CAB and non-CAB
- Buy-in/Buy-out concepts
- Wholesale material budgeting
- ICP initial budget requirements
- ICP replenishment budget requirements
- ICP repair requirement
- Mobilization requirements
- CARES
    - Maximum effectivity
    - Minimum funds investment
    - Adjustment of safety level/economic order quantity to achieve the above
- Retail material budgeting

Chapter Ten Special Topics

- Weapons System Management
    - Budgeting

    - Levels setting
    - Performance measurement
    - Organizational Impact - The material logistics team concept
    - Industrial Demand Forecasting (IDF) and "Shared Risk"

- Closed Loop Aeronautical Management Program (CLAMP)/Fleet Intensified Repairables Management (FIRM) Program
- High Intensity Management
- Item essentiality
- Material positioning

A.2 GRADUATE REQUIREMENTS TEXT STATEMENT OF WORK

19 JAN 1983

MEMORANDUM

From: SUP-00X
To: SUP-00

Subj: Graduate Requirements Text

Encl: (1) Statement of Work for a Graduate Level Text on Requirements Determination

1. I have re-vamped the proposed graduate requirements text as follows:

- Text Coverage is limited to the basics of the requirements determination process as originally discussed. Focus is exclusively on the general concepts of how the Navy determines requirements both in provisioning and replenishment.

- As constructed, the text will be maintainable over time by the ICPs and will not be subject to extreme perishability - would envision a three year update cycle.

2. Enclosure (1) is forwarded for approval and signature...competitive, about $90,000...100 copies...ready by summer.

C. R. WEBB

Statement of Work
Developing a
Graduate Level
Text on
Navy Requirements Determination

Objective: To develop a credible, graduate-level text on the process of requirements determination in the Navy.

Application: For use at NPGS Monterey and, as desired, in the NSCS UADPS-SP course/UICP Academy.

Assumptions:

1) Text will be oriented to the basics of the requirements determination process as seen by the item manager/stock control supervisor.

2) Text will include specific in-depth coverage of both Navy retail and wholesale requirements determination.

3) Text will address both the provisioning and replenishment scenarios.

4) Text will deal with afloat levels and stock point retail levels as well as wholesale levels.

5) Emphasis will be on the concepts of requirements determination and the basics of the process; mathematical models will be treated in appendices.

6) The special place/complications of repairables will be treated in detail.

7) Text will be specifically focused on Navy policies/processes and will utilize case examples of actual Navy items/equipments.

8) The impact of the requirements determination decision on required funding, procurement, material distribution, and warehousing will be fully explored.

9) Navy will identify and make available for consultation recognized experts at NPGS, NAVSUPHQ, SPCC, ASO and FMSO.

10) NPGS will provide behavioral objectives to be satisfied by the contractor in the development of the text.

General Scope:

- The Role of Navy Requirements Determination
- Basic Inventory Management Concepts

Enclosure (1)

- The Range Decision
  - Provisioning
  - Replenishment
- The Depth Decision
  - Provisioning
  - Replenishment
- Provisioning Concepts and Methods
- Forecasting Methods
- Wholesale Requirements Determination
  - Stratification-Based Requirements
  - Planned Program Requirements
  - Mechanics of Supply Demand Review
  - CARES
  - Financial Controls
  - Procurement Impacts
- Retail Requirements Determination
  - Demand-Based
  - Non-Demand Based
  - Mechanics of Replenishment Review
  - Stock Point Analyzer
  - Financial Controls
  - Workload Impacts
- Repairables
  - The Repair Decision
  - Retrograde Cycle Concepts
  - Intermediate Maintenance and Pool Requirements
  - Wholesale Retail Level Computations

- Long-Supply and Excess
- Budget Formulation and Execution

- Chapter One — Basic Inventory Management Concepts
- Chapter Two — Provisioning Concepts and Policies
- Chapter Three — Wholesale Replenishment Methods
- Chapter Four — Retail Replenishment Methods
- Chapter Five — Material Budgeting and Funds Control

Required Coverage:

- Length not to exceed 200 pages.
- Number of cases not to exceed four (4) cases

Project Milestones:

Identify/Position Resources	1 Mar 1983
Develop Proposed Text Outline with Specific Topics to be Discussed	15 Mar 1983
NAVSUP/NPGS Approval of Text Outline	30 Mar 1983
Submit Draft Chapters (Approx Three/Month Over Period Apr 1983 - May 1983)	31 May 1983
Develop Case Material	15 Jun 1983
SUP/NPGS/ICP/FMSO Review and Approval	30 Jun 1983
Final Publication (100 copies)	30 Jun 1983

Inventory Management - MN 3377
Winter 1988

Instructor:	Tom Moore	Office Hours:
Office:	Ingersoll 202	Mon 1500-1700
Phone:	x2642 or 384-3234	Tue 1500-1600
		Th 1400-1500
		By appointment

Text: NAVSUP Publication 553, "Inventory Management", NSN 0530-LP-553-0000.
Handouts will also be provided to supplement the text.

Learning Objectives:

1. Be able to describe the management and computational procedures which the Navy has approved for procurement, storage and distribution of wholesale and retail materials which support Navy activities. Be able to describe the assumptions, limitations and applications of these computational procedures. Primary emphasis will be placed on the procedures used to determine what, when and how much material to procure.

2. Be able to describe the uses, assumptions and limitations of the computational procedures used to forecast the central tendency and dispersion of demand and procurement leadtime for items of supply.

3. Be able to describe and apply the most commonly used models for the provisioning of initial stocks of consumable and repairable materials. Be able to describe the who, where and what of the overall provisioning process.

4. Be able to describe the Navy's procedures for requesting funds from Congress for consumable and repairable materials, and for allocating these funds once they are obtained.

Course Outline

Week	Topics	Reading Assignment
1, 2	DOD overview. Basic inventory management concepts. Probabilistic demand distributions.	Ch. 1
3	UICP files and software at ASO and SPCC. Forecasting demand.	Ch. 3
4, 5	Computation of inventory levels for consumables and repairables. Take home exam 1.	Ch. 3, App. A
6, 7	Wholesale provisioning.	Ch. 2
8, 9	UADPS-SP. SUADPS.	Ch. 4
10	Retail provisioning.	Ch. 4, Ch. 2
11	STRAT and CARES. Budgeting and the Navy stock fund. Take home exam 2.	Ch. 3, Ch. 5-I Ch. 5-I, 5-II

Grading:

Your course grade will be based on:

Two take home exams	50%
Term project	25%
Problem sets & practical exercises	25%

Problem sets will be due as assigned, usually in 3-7 days. They will be graded on a pass/fail basis. They are intended to give you an opportunity to learn about the dirty details of the computations used in Navy inventory management. You will receive more information about the term project in a few days.

[1]Office hours on Tuesdays and Thursdays may be affected by faculty seminars and departmental meetings. If you can, please check with me before attempting to see me on a Tuesday or Thursday. You are always welcome to make an appointment to see me.

APPENDIX B

INVENTORY MANAGEMENT QUESTIONNAIRE

From: Naval Postgraduate School Administrative Sciences Dept.
To: Supply Corps Officer Graduates of NPS Monterey

Subj: REQUEST FOR INPUT CONCERNING THE POSTGRADUATE EDUCATIONAL NEEDS OF SUPPLY CORPS OFFICERS IN THE AREA OF INVENTORY MANAGEMENT

Encl: (1) Inventory Management Questionnaire

1. A majority of Supply Corps officers attending the Naval Postgraduate School are required to take a one quarter course in basic Inventory Management (MN-3377). According to our records you should have taken this course as part of your NPS curriculum.

2. As an input to the upcoming curriculum review and as part of a student thesis project this questionnaire is being circulated to assist the Naval Postgraduate School in determining the educational needs of Supply Corps officers in the area of Inventory Management.

3. Please complete the enclosed questionnaire and return it to the following officers as soon as possible. Your expertise and comments will be of great benefit to future students at NPS and the Supply Corps.

R. Logue LCDR, SC, USN
B. Gearey LT, SC, USN

INVENTORY MANAGEMENT QUESTIONNAIRE

Biographical Information

Name:_____
Rank:_____
NPS Curriculum:_____
Mo/Yr of Graduation:_____

1. Billet History (Since graduation from NPS)

A. Current Billet:_____
Billet Description:_____
_____
_____

B. Previous Billet:_____
Billet Description:_____
_____
_____

C. Previous Billet:_____
Billet Description:_____
_____
_____

2. Did you take the one quarter course in Inventory Management (MN-3377) which was first offered in the Summer of 1984?

YES NO

"DO NOT COMPLETE THE QUESTIONNAIRE
IF YOU DID NOT TAKE THE COURSE"

INVENTORY MANAGEMENT TEXT AND GENERAL COURSE QUESTIONS

1. The text used in the MN-3377 Inventory Management course is NAVSUP Publication #553- Inventory Management. Please answer the following questions concerning the NAVSUP Pub-553:

A. CLARITY- Was the text readable?

POOR BELOW AVERAGE AVERAGE GOOD EXCELLENT

B. CONTENT- Was the information you needed for a course in Inventory Management contained in the text?

POOR BELOW AVERAGE AVERAGE GOOD EXCELLENT

C. CONTENT- did you find the information in NAVSUP Pub-553 to be current and accurate after you graduated and began working in the Supply system again?

POOR BELOW AVERAGE AVERAGE GOOD EXCELLENT

D. Do you use the publication in your current billet?

WEEKLY MONTHLY QUARTERLY ANNUALLY NEVER

E. If you use the NAVSUP Pub-553 with what frequency do you utilize the following chapters as a reference?

Chapter 1: Basic Inventory Management Concepts

WEEKLY MONTHLY QUARTERLY ANNUALLY NEVER

Chapter 2: Provisioning Concepts and Policies

WEEKLY MONTHLY QUARTERLY ANNUALLY NEVER

Chapter 3: Wholesale Replenishment Concepts and Policies

WEEKLY MONTHLY QUARTERLY ANNUALLY NEVER

Chapter 4: Retail Replenishment Concepts and Policies

WEEKLY MONTHLY QUARTERLY ANNUALLY NEVER

Chapter 5: Section 1- Material Budgeting at the ICP's

WEEKLY MONTHLY QUARTERLY ANNUALLY NEVER

Chapter 5: Section 2- Retail Financial Management

WEEKLY MONTHLY QUARTERLY ANNUALLY NEVER

2. Did the MN-3377 Inventory Management course meet your needs and expectations as a one quarter course in Navy Inventory Management?

YES NO

3. Did the course place too much emphasis on the mathematical models?

YES NO

4. Please provide any general comments regarding course applicability to your current or future Supply Corps billets:

5. The following is a prospective list of topics in the area of Inventory Management. Based on your Supply Corps and postgraduate school experience choose the TEN topics that you feel should be included in a postgraduate level basic Inventory Management course. In other words, what subjects would have benefited you the most? Rank your ten choices in order of importance from ONE to TEN. (Note: ONE being the most important topic).

_____ OVERVIEW OF THE SUPPLY AND MATERIAL DISTRIBUTION SYSTEM
-- Key organizations and functions
-- Levels of inventory management

_____ BASIC INVENTORY MANAGEMENT CONCEPTS
-- Types of inventory costs
-- Basic inventory theory (EOQ model)
-- Reorder point and requisitioning objective
-- Measures of effectiveness

_____ ALLOWANCE LIST DEVELOPMENT
-- Weapons systems file
-- COSAL, AVCAL, FILL, COSBAL, TARSLL, SHORECAL

_____ FORECASTING MODELS AND PROCEDURES
-- Demand probability distributions
-- Demand forecasting
-- Forecasting other variables (eg.-leadtime)

_____ CURRENT AND FUTURE INVENTORY MANAGEMENT DEVELOPMENTS
-- Alternate inventory management systems
-- SPLICE/SPAR
-- Just-in-Time/KANBAN systems

_____ WHOLESALE REPLENISHMENT CONCEPTS AND POLICIES
-- UICP Overview
-- Consumable/repairable requirements determination models
-- Planned program requirements

_____ DISPOSAL
-- UICP methods
-- DOD disposal policy and methods

_____ RETAIL REPLENISHMENT CONCEPTS AND POLICIES
-- Retail Inventory Management and Stockage Policy (RIMSTOP)
-- UADPS-SP programs and files
-- Retail requirements determination models
-- Levels setting

_____ SHIPBOARD UNIFORM AUTOMATED DATA PROCESSING SYSTEM (SUADPS)
-- SUADPS files and reports
-- Levels setting

_____ INVENTORY ACCURACY METHODS
-- Inventory sampling techniques
-- Quality assurance
-- Supply system/ICP accuracy methods

_____ INVENTORY MANAGEMENT AT THE HARDWARE SYSTEMS COMMANDS
-- Policies and procedures

_____ CURRENT INVENTORY MANAGEMENT PROBLEM ISSUES
-- Effects of funding constraints
-- Inventory accuracy
-- Repairables management
-- Multi-echelon stockage

_____ WHOLESALE PROVISIONING PROCESS
-- Integrated logistic support (ILS) planning
-- Inputs to provisioning
-- Roles of PSICP, SYSCOM, and Contractors
-- Level of repair analysis

_____ WHOLESALE PROVISIONING MODELS
-- Requirements determination models

_____ OVERVIEW OF OTHER MATERIAL INVENTORY SYSTEMS
-- DLA
-- Navy Industrial Fund activities
-- POL, Ammunition

_____ WHOLESALE REPAIRABLES MANAGEMENT
-- Repair decision
-- Carcass tracking
-- Levels

_____ MATERIAL BUDGETING
-- Navy Stock Fund
-- Budget requirements determination
-- STRAT/CARES

_____ OTHER
(Give each other topic you include a number ranking as one of your top ten)

_____ OTHER

6. For each topic area listed below indicate the frequency wi which you have needed or used knowledge of the topic since graduating from NPS. Use the following key:

A- Never
B- 1 or 2 times per year
C- 3 to 6 times per year
D- Monthly
E- Weekly
F- Daily

_____ Organization of the Navy Supply and Material Distributi System

_____ Economic Order Quantity (EOQ) model

_____ Inventory management measures of effectiveness

_____ COSAL/AVCAL or other allowance list development

_____ Weapons systems file (WSF)

_____ Forecasting models and procedures

_____ Demand probability distributions

_____ SPLICE/SPAR development

_____ UICP policies and procedures

_____ Wholesale requirements determination models

_____ Disposal policy and procedures

_____ Retail Inventory Management and Stockage Policy (RIMSTOP)

_____ UADPS-SP programs and files

_____ Retail requirements determination models

_____ SUADPS files and reports

_____ Inventory accuracy methods

_____ Inventory management policy and procedures at the SYSCOM's

_____ Management of repairables assets

_____ DLA inventory management policies and procedures

_____ Navy Industrial Fund inventory management policies

_____ Wholesale provisioning process

_____ Wholesale provisioning requirements determination models

_____ Navy Stock Fund procedures

_____ Budget requirements determination at the ICP's

_____ STRAT/CARES

List any other specific inventory management topic areas that you have used on at least a monthly frequency:

"THANK YOU FOR YOUR ASSISTANCE WITH THIS PROJECT"

APPENDIX C

REPRESENTATIVE GENERAL SURVEY COMMENTS

1. COMMENTS CONCERNING THE MN3377 COURSE

"The course fell short of my expectations. The 'cookbook' method of working through some of the inventory problems was not effective in helping me understand how an ICP balances the funding constraints with the inventory objectives."

"It is important to know that the models are complex and what some of the variables can do or how they can effect the equations. The detail and mechanics presented in this course was more than required for a manager's role and unfortunately at the expense of the big picture."

"The course is needed, but in a different format. Concepts, basic models, and policies should be addressed."

"There was no attempt made to teach management of inventory. Let the ICP's and stock points teach specific models and have NPS teach basic concepts and management tools."

"When I took the course I felt it was too detailed. Since reporting to SPCC I was surprised just how many of the details I use."

"This course would have been more beneficial if management issues were addressed. I saw little utility to be derived from a quarter of number crunching."

"I feel that the course offered good information useful to all Supply Corps officers. However, it should be more directed at management of inventories and less on how the computer models work."

"The course did open my eyes to some of the complexities involved in managing items at an ICP. However, we definitely got bogged down in the mathematical models."

"Supply Corps officers are managers not mathematicians. The course emphasizes the mathematical end of the subject rather than how the models can and should be used."

"The course provided a relatively good overview of how the system works and what can be expected."

"The course could have been useful. Emphasis should be placed on the information you get out of the computer and what it means."

"Models are needed, however the course should not be comprised of only models."

"I believe that the course could be extremely useful to all Supply Corps officers, not just inventory management students, if the course can be restructured into how the Navy/DOD manages their inventories instead of a mathematics course."

"Do not do away with the course. Rather, strengthen it by use of concepts rather than specifics."

"Probably the most disappointing course I took at NPS. It did not come close to my expectations. The course should address the inventory management system and decision making process."

"The emphasis should be on maintaining inventory accuracy."

"It is not in-depth enough for inventory management experts, but it is more than sufficient for Supply Corps professional development."

"The course should have been called Inventory Modeling. There was no attempt made to teach management of inventory."

"I was disappointed because there was such a heavy emphasis on the math models and very little time was spent on inventory management theory and concepts. I felt cheated by the whole experience."

"I remember being frustrated with all the number crunching in the course, but I think it made me understand the system better. What I did not get was the rationale and/or reasoning behind the formulas."

2. COMMENTS REGARDING THE NAVSUP PUBLICATION 553

"The P-553 is a poorly written manual not intended for course instruction."

"The text was out of date and far too mathematically oriented."

"The P-553 is a technician's pub that will be of no use to me."

"The text, although readable, was poorly organized from a manager's point of view."

APPENDIX D

D.1 19TH SPCC ICP ACADEMY SCHEDULE

DAY/DATE	TIME	SUBJECT
		ADMINISTRATION
Tuesday 12 Jan	0800-0830	Class Administration
	0830-0845	ICP Goals & Objectives
		OVERVIEW
	0900-0930	SPCC Basic Business
	0930-1030	UICP Mission/Function Overview
	1030-1130	SPCC Organization and Decision Making
Wednesday 13 Jan	0800-0830	Weapons Systems Support Overview
	0830-0900	Fleet Industrial Support Overview
	0900-0930	Customer Service Department Overview
	0930-1000	Comptroller Overview
	1000-1100	Planning and Operations Analysis Overview
	1100-1200	NAVSUP/SPCC Relationships
Thursday 14 Jan	0800-0900	Platform Management Perspective
	0900-1000	SPCC Program Manager Perspective
	1000-1130	3M
Tuesday 19 Jan	0800-0900	Basic Inventory Theory
	0900-1100	The Maintenance/Supply Team
Wednesday 20 Jan	0800-1000	NAVSEA Program Management
	1000-1200	Basic NSF and Base Operation Budgeting Overview
		PROVISIONING/CONFIGURATION MANAGEMENT
Thursday 21 Jan	0800-0930	Provisioning Models
	0930-1100	Provisioning
Monday 25 Jan	0800-0930	Material Budget for Initial Spares
	0930-1100	Best Replacement Factor

DAY/DATE	TIME	SUBJECT
Tuesday 26 Jan	0800-0900	Technical Functions
	0900-1000	COSAL/FOMIS (Fleet Outfitting Management Information System)
	1000-1130	Logistics Readiness Improvement Program (LRIP)
	INTEGRATED MATERIAL MANAGEMENT	
Wednesday 27 Jan	0800-0900	Cataloging
	0900-1000	DLA Interface
	1000-1200	Configuration Accounting
Thursday 28 Jan	0800-0900	Weapons Systems Support Program
	0900-1000	UICP Files (WSF-MDF, WSFD)
	1000-1030	Files Maintenance (C10, C14, V30, V09)
	1030-1100	Change Notices
	REQUIREMENTS DETERMINATION/REPLENISHMENT	
Monday 1 Feb	0800-1000	UICP Model/Level Setting
	1000-1200	Stratification
Tuesday 2 Feb	0800-0930	Replenishment BEP (Budget Execution Plan)
	0930-1100	Budget Execution
Wednesday 3 Feb	0800-0930	Allot/Inven. Acctg.
	0930-1100	Planned Program Requirements and Transaction Item Reporting
Thursday 4 Feb	0800-0920	Stock Point Interface
	0930-1100	SDR
Monday 8 Feb	0800-0930	IM Tools
	0930-1130	Repairables Initiatives
Tuesday 9 Feb	0800-1000	Repairables Management
	1000-1130	IM Perspective
Wednesday 10 Feb	0800-0900	Disposal
	0900-1030	Material Pricing
	PROCUREMENT	
Thursday 11 Feb	0800-1100	Contracting
	1100-1200	Contract Admin.
Tuesday 16 Feb	0800-0900	Breakout/Competition

DAY/DATE	TIME	SUBJECT
	CUSTOMER SUPPORT	
	0900-1000	Requisition Processing
	1000-1100	Customer Service/CASREP
Wednesday 17 Feb	0800-1100	RIMSTOP/OSI/Load Lists
Thursday 18 Feb	0800-1000	Industrial Support/SAMIS
	DATA SYSTEMS	
	1000-1030	SPCC Data Processing
	1030-1100	SPCC Data Communications
	1100-1200	Transition Status
Monday 22 Feb	0800-1000	Resystemization
	1000-1130	SPAR
	SPECIAL PROGRAMS	
Tuesday 23 Feb	0800-1100	Strategic Submarine Support
	1100-1200	Security Assistance Program
Wednesday 24 Feb	0800-0900	Mobilization Planning (Material)
	0900-1000	AMMO
	1000-1200	Nuclear Program
Thursday 25 Feb	0800-0900	FMSO Basic Business
	0900-1100	ASO Brief
	SUMMARY	
Monday 29 Feb	0800-0930	Mission/Function Review
To Be Announced		Washington Flag Officer
Thursday 3 Mar	0900-1100	Command Perspective
	1130-1300	Graduation--Luncheon--Class Photo (Dress Blues for Military; appropriate attire for Civilian)

D.2 WINTER 1988 ASO ICP ACADEMY SCHEDULE

DATE	TIME	SUBJECT
		ADMINISTRATION
1/12	0800-0810	Course Introduction
	0810-0820	Executive Officer's Opening Remarks
	0820-0850	ASO Overview ("Brickyard")
		PRE-ASO WEAPON SYSTEM MGMT
	0900-0910	Meet WS (Weapons Support)
	0910-0940	Integrated Logistics Support
	0950-1020	Provisioning Process
	1030-1100	Interim Contractor Supply Support
	1110-1150	Configuration Management
1/13	0800-0845	Provisioning, Production, and Quality Control
		UICP DATA BASE
	0850-0940	Basic Process
	0950-1040	Files Integrity
	1050-1100	Meet PL (Planning)
	1100	Distinguished Guest Speaker RADM J. B. Whittaker, SC, USN; Assistant Commander, Inventory and System Integrity, Naval Supply Systems Command
1/14	0800-0840	ASO Information Center
	0850-0920	ADP Security
	0930-1010	Data Processing overview
	1020-1100	ADP Modernization

MISCELLANEOUS

1/15	0800-0845	USMC Aviation Support
	0850-0925	Facilities Management
	0930-1005	EEO Program
	1005-1035	Managing to Payroll
	1045-1115	Productive Unit Resourcing (PUR)
	1125-1215	ASO Learning Center

REQUIREMENTS DETERMINATION

1/19	0800-0930	Elements of Inventory Management/Replenishment Requirements Determination
	0930-0940	Meet OP (Operations)
	0940-0950	Meet WM (Weapons Management)
	1000-1050	Fleet Support
	1100	Distinguished Guest Speaker RADM G. H. Strohsahl, Jr., USN; Program Director, Tactical Acft (PDA-10), Naval Air Systems Command
1/20	0800-0850	Stratification
	0900-0940	Material Returns Program
	0950-1040	Elements of Repair Requirements Determination
	1050-1140	Stratification Budget Process
1/21	0815-0905	Funding Process for Procurement
	0915-1000	Industrial Support
	1005-1045	Industrial Requirement Planning
	1055-1145	Contracting for Repair

PROCUREMENT

1/22	0800-0820	Meet CM (Comptroller)
	0830-0940	Purchase Regn Control/Intro to Branch OPTARS

	0950-1040	Responsibilities of an Inventory Manager
1/26	0800-0930	Buying Process
	0930-0940	Meet PG (Procurement)
	1000-1100	Contract Administration
	1110-1200	Internal Review/Audits

COMPETITION

1/27	0800-0840	Project BOSS...Buy Our Spares Smart
	0845-0935	Competition/Breakout - Process & Procedures
	0940-0950	Meet CA (Competition Advocate)
	0955-1045	Business Plan Development and Execution
	1050-1150	International Logistics Programs

PSICP FUNCTIONS

1/28	0800-0830	Engineering Assistance
	0840-0925	Interservice Supply Support Nonconsumable Item Program DOD I & S System
	0930-1020	DLA Program Support
	1030	Distinguished Guest Speaker RADM J. E. Eckelberger, SC, USN; Executive Director, Supply Operations, Defense Logistics Agency

RETAIL REQUIREMENTS

1/29	0800-1200	POE Effectiveness Emergent Retail Programs AVCALs/SHORCALS Consumable Retail Requirement Development Wearout/Survival COSAL
	1300-1350	Planned Program Requirements

	1400-1450	Packaging, Handling, Storage, and Transportation

REQUISITIONING

2/2	0800-0830	WSM Interface
	0830-0900	ASO Expediting
	0910-1000	Carcass Tracking
	1010-1100	Inventory TIRs
	1110-1200	Central Accounting and Billing

MISCELLANEOUS

2/3	0800-0930	SPCC Orientation
	0940-1100	FMSO Orientation
	1110-1200	Navy Flying Hour Program
2/4	0800-1000	The Provisioning Process
	1010-1200	Supporting the Maintenance Plan
2/5	0900-0950	Introduction to the NAMP
	1000-1020	Closing Administrative Comments
	1100	Distinguished Guest Speaker RADM C. R. Webb, Jr., SC, USN; Dir, Material Division (OP-41), Office of the Chief of Naval Operations
		COMMANDING OFFICER'S CLOSING COMMENTS

D.3 CAREER SUPPLY MANAGEMENT COURSE

I. Phase I: Weapons Systems Acquisition and Development Process

Objective: To describe the organizations, policies, systems, and procedures utilized to acquire and develop logistical supportable weapons systems.

I.1 Navy/DOD Basic Organization

Objective: Brief overview of the activities involved in the systems acquisition and development process describing their role, organizational interface, influence and responsibilities.

Topics:

- Wiring diagram of the players
- General tasks performed by each organizational element including flow of funds overview
- Operating relationships

I.2 Planning, Programming, Budgeting System

Objective: To describe the DOD and Navy's PPBS and set the stage for more detailed discussion of secondary item budgeting.

Topics:

- Definition and relationship of planning, programming, and budgeting
- The POM Process
- Five Year Defense Program (FYDP)
- OPNAV sponsor roles
- Appropriation budget structure
- The budget process
- Budget flexibility

I.3 Weapons Acquisition Management and Operational Availability

Objective: To explain the weapons system acquisition process and the Integrated Logistics Support systems and policies utilized to support weapons systems.

Topics:

- Weapons Acquisition Process
  - -- Milestone decision points
  - -- Acquisition process/PPBS interface
  - -- Weapons System Review process
  - -- OPEVAL process
- Operational Availability
  - -- A_0 uses
  - -- Reliability, maintainability, supportability
  - -- Impact on equipment design, maintenance and supply

- Project Management
  -- Project Manager organization, authority, and responsibilities
- Integrated Logistics Support (ILS)
  -- Definitions, principal elements, reasons for ILS
  -- Life Cycle costing
  -- ILS Manager roles and responsibilities
  -- Design Support interface considerations
  -- The ILS Plan
  -- Logistics Review Group (LRG) and other ILS review

I.4 Maintenance Planning and Organization
Objective: To describe the maintenance planning process and maintenance organizations within the Navy. Explain how maintenance decisions influence ILS and supply considerations and requirements.
Topics:
- Maintenance planning process
  -- LSA, Failure Modes & Effects Analysis, LOR Analysis
- Levels of maintenance
- Configuration management and control
- Ship Maintenance interface with supply
  -- Maintenance trends
  -- Class maintenance plans
  -- Reliability centered maintenance
  -- Engineered operating cycles
  -- Fleet Modernization Program
  -- SAMIS
  -- SECAS
  -- Integrated Logistics Overhauls
- Aviation Maintenance
  -- Functions,responsibilities of maintenance echelons
  -- The NAMP

I.5 Provisioning
Objective: To describe the provisioning process and the role provisioning plays as the interface between supply and maintenance.
Topics:
- Provisioning cycle
- Provisioning inputs
  -- Provisioning Technical Documentation (PTD)
- Provisioning methods
- Provisioning decisions
  -- Maintenance level decisions
  -- Replacement rates
  -- Other decisions (essentiality coding, over-rides, etc.,)

- Ordering and delivery of support items
- Interim support procedures
- Follow-on provisioning

I.6 Allowance and Load Lists Development
Objective: To describe the policies and procedures utilized to develop allowance and load lists supporting organizational, intermediate and depot level maintenance of supported weapons systems.
Topic:
- Allowance preparation responsibilities
- Weapons System File (WSF)
- Surface/Subsurface Support
  -- Organizational level maintenance support allowance models (FLSIP, Mod FLSIP, MCO, sparing to availability)
  -- Intermediate level maintenance support (AD load list, SIMA, etc.,)
  -- Depot level maintenance support (shop stores, SRASL)
  -- Organizational level maintenance support (AVCAL, etc.,)
  -- Intermediate level maintenance support (AVCAL, rotatable pools)
  -- Depot level maintenance support (NARF OSI, etc.,)

I.7 Initial Requirements Determination
Objective: To describe how initial material requirements are developed and positioned in the supply system for new weapons systems.
Topics:
- Wholesale Requirements
  -- Demand Based
    --- Wholesale computational models
  -- Non-demand based
    --- Insurance items
    --- Numerical Stockage objective (NSO) items
    --- DLA and other service requirements
  -- Follow-on System Stock
- Retail Requirements
  -- Allowance and load lists
  -- Maintenance Assist Modules (MAMs)
  -- Installation and checkout spares
  -- Other retail requirements
  -- DLA and other service requirements
- New construction outfitting

I.8 Life Cycle Support
Objective: To discuss the role of NAVSUP and the ICPs in weapons system program management support throughout the life cycle of an equipment.
Topics:
- Recap of NAVSUP/ICP role prior to initial Fleet introduction of an equipment
- Weapons system program support after Fleet introduction
  -- ASCC information
  -- 3M system
  -- CASREP, DART, and other tools
- Weapons Systems Support Presentations

II. Phase II: Supply and Material Distribution System
Objective: To describe the structure, operation, policies, and procedures of the supply and material distribution system and its supporting subsystems.

II.1 Supply System Overview
Objective: To provide an overview of the structure roles, missions and major policies of the organizations comprising the Navy/DOD/National Supply System and to discuss integrated material management and the wholesale/retail split.
Topics:
- Functions common to all supply/distribution systems
- Wiring diagram and brief description of key organizations in the Navy/DOD/National Supply System and their roles
- Key DOD policies governing the supply system
  -- Integrated material management
  -- RIMSTOP
    --- Discussion of consumer, intermediate, and wholesale levels of inventory
  -- Other policy directives
- General Services Administration
- Defense Logistics Agency
  -- Defense Supply Centers
    --- Item management role
  -- Distribution depots and Navy Specialized Support Points
  -- Other DLA activities and their roles
    --- DLSC, DCAS, DPDS, DIPEC, etc.,
- Army and Air Force Commands with Navy Interface
  -- WSSAs/ISSAs
- Naval Supply Systems Command overview
  -- Missions
  -- Internal organization
  -- Subordinate commands

- Requisitioning Channels
  -- What they are
  -- Why they are important
- Military Standard Logistics Data Systems

II.2 Navy Wholesale Stock Management
Objective: To describe how the Navy ICPs manage wholesale material with special emphasis on repairables management.
Topics:
- Role and tools of the wholesale inventory manager
- Major UICP Files
- Major UICP system application operations
- Requirements determination
- Inventory levels setting
- Weapons Systems Segmentation
- Repairables Management
  -- IRAM objectives and policies
  -- Why repair
  -- The Repair Cycle - roles, responsibilities and procedures
  -- Repair Levels
  -- Repairables Requirements Determination
  -- SPCC Repairables Programs
  -- ASO Repairables Programs
  -- PICA/SICA, interservice support

II.3 Secondary Item Budgeting
Objective: To describe the budget processes for procurement and repair of wholesale/retail spares and repair parts.
Topics:
- Stratification
- Accounting classes
- The Stock Fund
  -- What it is
  -- Why it exists
  -- How large it is
  -- How it works
  -- Some basic principles
- Budget Cycles
  -- Comparison of APA and Stock Fund
  -- Budget submission, review, and approval process
- Stock Funding Depot Level Repairables
  -- Advantages
  -- Pricing mechanisms
  -- Developing customer budgets
- Budget Execution Policies
- Accounting and billing for material
  -- Brief overview of CAB and non-CAB
- Navy Industrial Fund

II.4 Procurement Overview
Objective: To provide a brief overview of secondary item procurement regulations, procedures and practices governing procurement operations.
- The DAR/FAR
  -- Types of contracts
  -- Some governing principles
- Competition
  -- Technical data influence
  -- Breakout
  -- BOSS initiatives
- ICP procurement operations
- Stock Point procurement operations

II.5 Retail Stock Management
Objective: To describe the structure, objectives, system characteristics and operation of the Navy Retail System.
Topics:
- Objectives of the Navy Retail System
- Retail System structure and responsibilities
  -- NAVSUP
  -- FMSO
  -- Stock Points
  -- ICPs
- Retail System (Stock Points) characteristics
  -- Decentralized management
    --- Set own levels fixed vs VOSL
    --- Pull material
    --- Control allocated funds
- Inventory accounting
- Demand information
- Stock policies
- Shop Store/Ready Supply Store/SERVMARTS/DOSS
- UADPS-SP
  -- Overview of major operating characteristics

II.6 Physical Distribution
Objective: Describe the systems and procedures of physical distribution, handling, and storage of material within Navy Stock Points with special emphasis on inventory accountability.
- Daily environment
  -- Material receiving, storing, rewarehousing, issuing, conducting physical counts
- Materials handling equipment
- Developments in warehousing systems
  -- Current environment
  -- NISTARS/NAVADS

- Physical inventory policies/procedures
  -- NAVSUPSYSCOM's number one priority
  -- Report and Plan of action on the Inventory Accuracy Problem
- LOGMARs
  -- Current and potential uses

II.7 Effectiveness Measurement of the Supply System
Objective: To discuss various interpretations of "Readiness" and look at some effectiveness indicators (and their limitations) to analyze how well the supply system is supporting weapons systems and functioning overall.
Topics:
- Fleet readiness
- Material readiness
- Operational Availability
- CASREP System
- 3M system
- UMMIPs timeframes
- Supply Material Availability
- Point of entry effectiveness
- COSAL effectiveness
- Availability delay

II.8 ADP and Telecommunications in the Supply System
Objective: Review the role of the computer and telecommunications in the supply system and describe some current capabilities and limitations plus what's on the drawing board for future hardware and software.
Topics:
- DAAS
- Supply ADP hardware
- Function and operation of the Navy Central Design Agencies
- Resolicitation (UICP and SPAR)
- Shipboard ADP systems

II.9 Transportation of Material and Supplies
Objective: Describe the organizational elements of the Navy/DOD transportation subsystem and the procedures and systems related to the movement of Navy material and supplies.
Topics:
- Principal elements of the DOD transportation system and major functions of each
- Technical and managerial responsibilities of the Navy traffic manager
- Transportation statistics and volume
- Transportation budgeting and policies

II.10 Role of the Fleet in the Supply System
Objective: To review and discuss the contributions the Fleet can make to assist the Material Command in providing Weapons System Support.
Topics:
- Fleet responsibilities
  -- Follow basic storekeeping
  -- 3M reporting
  -- Configuration change reporting
  -- Accurate use of COSAL
    --- Results achieved through Integrated Logistics Overhauls
  -- Follow-on equipment maintenance plan

II.11 Productivity Enhancement
Objective: Discuss productivity measurement, the importance of productivity improvement in a resource constrained environment and potential areas for increasing productivity.
Topics:
- Productivity measurement in the Supply Systems Command
- Areas for productivity improvements
  -- Office Automation
  -- Material movement

III. Phase III. Civilian Personnel Management
Objective: Outline the organizational elements of Navy Civilian Manpower Management and discuss civilian personnel management topics of current importance.
Topics:
- Organization and primary functions of the Office of Personnel Management
- Civilian employee appointment procedures
- Grade salary and leave systems
- Procedures used in civilian employee position classification including classification standards and management responsibilities relate to position classification
- Civilian employee performance evaluation system
- Employee grievances and appeals procedures
- Disciplining civilian employees
- Labor relations program for government employees

IV. Officer Fitness Report Preparation
Objective: Discuss preparation of officer fitness reports for the middle grade officer who will be supervising more junior officer personnel.
Topics:
- Fitness report preparation

APPENDIX E

PROPOSED MN-3377 COURSE OUTLINE AND LEARNING OBJECTIVES

The schedule of lesson topics outlined in this appendix provides for 10 weeks (40 hours) of classroom instruction. Since the standard Naval Postgraduate School quarter consists of 11 weeks, this allows one week for testing, holidays and other administrative requirements. The following is a detailed outline and set of learning objectives for the revised Inventory Management course.

Week 1

Supply System Overview and Concepts (2 hours)

-- Be able to name and describe the primary functions of the Navy Supply System

-- Know the elements of Supply/Inventory management

-- Explain the principles of integrated management policy as it applies to the DOD supply system

-- Be able to define and provide examples of the following terms:

End Item	Repairable
Principal Item	Consumable
Secondary Item	Cognizance of Material (COG)

-- Describe the concept of stock coordination

-- Explain the objectives of the DOD standardization policy as they pertain to Navy inventory management

-- Describe the principles of the supply cataloging function

-- Define and provide examples of the three levels of maintenance

-- Define and know the characteristics of the three levels of inventory

-- Be able to describe the function served by war reserve material

-- Be able to define the following terms:
War material requirement (WMR)
War reserve material requirement (WRMR)
Prepositioned war reserve material requirement (PWRMR)

DLA and Navy Supply System Organization (1 hour)

-- Describe the scope and importance of DLA inventory management

-- Know the key DLA organizations and their functions

-- Describe the role of the DLA supply centers

-- Describe the role of the DLA distribution system

-- Describe the role of the DLA service centers

-- Know the key Navy supply system organizations and their functions

-- Describe the role of the Commander Naval Supply Systems Command (NAVSUP) and be familiar with the NAVSUP internal chain of command

-- Describe the program and supply support functions of an Inventory Control Point (ICP)

-- Describe the functions of a Navy stock point

-- Describe the functions of the Fleet Material Support Office

Basic Inventory Theory and Terminology (1 hour)

-- Be able to describe the four functions of inventories

-- Discuss the classification and variables of the inventory problem

-- Be able to describe and understand all the costs associated with the management of inventories

Week 2

Basic Inventory Theory and Terminology (3 Hours)

-- Describe the basic decisions and operating policies associated with inventory management

-- Define and be able to illustrate graphically the continuous and periodic review inventory models

-- Describe the major assumptions underlying the EOQ model

-- Describe the application of the economic order quantity (EOQ) formula and explain how it is derived from the inventory total cost equation

-- Calculate economic order quantities using the EOQ formula

-- Explain the concepts of reorder points and quantities

-- Define procurement leadtime and explain its effect on inventory levels

Basic Forecasting Principles (1 hour)

-- Explain the function of forecasting in inventory management

-- Describe and be able to compute forecasts for demand and other variables using the following techniques:
    Last period demand
    Arithmetic average
    Moving average

Week 3

Basic Forecasting Principles (1 hour)

-- Describe and be able to compute forecasts using the exponentially weighted moving average (EWMA) method

-- Discuss the purpose and use of trend and seasonal corrections in forecasting

-- Define and discuss the Navy's use of Mark Codes to classify item demand

Overview of Risk and Safety Levels (2 hours)

-- Explain the principles of stochastic demand and leadtime
-- Describe the purpose of safety stock

-- Define costs of stockout or backorders

-- Explain the concept of risk and how it relates to the setting of inventory stockage levels

-- Compute reorder points and safety levels using the normal and Poisson distributions

-- Define and make calculations using the Navy risk formula

Supply System Performance Measures of Effectiveness (1 hour)

-- Explain the purpose and tradeoffs of the various measures of effectiveness (MOEs)

-- Define operational availability and its components:
    Mean time between failures (MTBF)
    Mean time to repair (MTTR)
    Mean supply response time (MSRT)

-- Compute operational availability

-- Discuss the performance measures defined by the Retail Inventory Management and Stockage Policy (RIMSTOP) to include:
    Gross effectiveness
    Net effectiveness
    Average customer wait time

-- Describe the use of system material availability (SMA) as a performance measure

Week 4

Initial Provisioning Concepts, Policies and Models (4 hours)

-- Define the provisioning process for Navy weapons systems

-- Describe the key organizations and their roles in the provisioning process

-- Describe the following inputs to provisioning:
    Performance Data
    Maintenance Concept
    Program Support Data (PSD)
    Logistic Support Analysis (LSA)
    Provisioning Technical Documentation (PTD)
    Source, Maintenance and Recoverability (SM&R) Codes

-- Discuss and explain the importance of the derivation of replacement factors for spare parts

-- Discuss and be familiar with the least life cycle cost principle of the Level of Repair Analysis (LORA) model

-- Define demand based, insurance and numeric stockage objective items

-- Describe and be able to compute the Time Weighted Average Monthly Program (TWAMP)

-- Explain how replacement factors and TWAMP are used to forecast demand during provisioning

-- Be familiar with the ICP models used to compute provisioning requirements

-- Describe the strengths and weaknesses of the provisioning models and explain the effect of varying model parameters

Week 5

Wholesale Replenishment Concepts and Policies (4 hours)

-- Explain the role of the wholesale level in the Navy's inventory management system

-- Describe the purpose and function of the following Uniform Inventory Control Point (UICP) files and operations/applications:
    - Master Data File (MDF)
    - Repairables Management File (RMF)
    - Planned Program Requirements File (PPR)
    - Due-In/Due-Out File (DDF)
    - Inventory History File (IHF)
    - Requisition Processing
    - Transaction Item Reporting
    - Levels Setting

-- Explain the method used by the ICP to forecast demand

-- Discuss the process of Supply Demand Review

-- Define the elements of the four-digit cog for both SPCC and ASO and explain how they are used for item management

-- Discuss the importance of repairables management at the wholesale level

-- Describe the following terms as they relate to repairables management:
    - Regenerations
    - Repair In-process Time
    - Repair Cost
    - Repair Level
    - Repair Cycle
    - Repair Survival Rate
    - Repair Turnaround Time

-- Be familiar with the models used to determine replenishment requirements for consumable and repairable items

-- Describe the strengths and weaknesses of the UICP replenishment models

Week 6

Retail Inventory Management Policies and Procedures (4 hours)

-- Discuss the policies and significance of the DOD Retail Inventory Management and Stockage Policy (RIMSTOP)

-- Describe the functions of the Uniform Automated Data Processing System-Stock Points (UADPS-SP)

-- Discuss the major UADPS-SP programs/files and their functions as follows:
    Master stock item record (MSIR)
    Stock point replenishment analyzer
    Demand history

-- Describe the function of the Shipboard Uniform Automated Date Processing System (SUADPS)

-- Explain the concept of demand based inventories and describe the criteria used by the retail activities to compute range and depth of inventories

-- Describe the models used to compute levels at the retail intermediate level to include:
    Economic Range Model (ERM)
    Variable Operating and Safety Level (VOSL) Model

-- Explain the policy of fixed allowances for depot level repairables

Week 7

Development of Allowance Lists (4 hours)

-- Describe the purpose of developing allowance lists

-- Define and state the purpose for each of the following allowance lists:
    Coordinated Shipboard Allowance List (COSAL)
    Coordinated Shorebase Allowance List (COSBAL)
    Aviation Consolidated Allowance List (AVCAL)
    Tender and Repair Ship Load List (TARSLL)
    Fleet Issue Load List (FILL)

-- Describe how an allowance is built

-- Define allowance list objectives and level of protection

-- Describe what factors influence the determination of allowances

-- Describe the differences, strengths and weaknesses of the following allowance list models:
    Fleet Logistics Support Improvement Program (FLSIP)
    Modified FLSIP
    Maintenance Criticality Oriented (MCO)

-- Describe the function of the Fleet Issue Load List (FILL)

Week 8

Material Budgeting (4 hours)

-- Discuss the relationship of material budgeting and inventory management

-- Define and provide examples of the type of material procured with the Appropriated Purchases Account (APA) and the Navy Stock Fund (NSF)

-- Explain how the "revolving fund" concept applies to the Navy Stock Fund and how the fund recoups its costs of operation

-- Describe the manner in which the NSF is controlled by the use of budget projects

-- Explain how depot level repairables are managed within the NSF

-- Discuss how funding is developed for initial spares

-- Describe the Computation and Research Evaluation System (CARES) and how it is used to help achieve wholesale System Material Availability (SMA) goals

-- Discuss the stratification process and its role in supporting budget submissions

-- Describe a budget execution plan

-- Discuss FMSO's role as the Navy Retail Office with respect to NSF management

Week 9

Inventory Accuracy/Quality Assurance Methods (2 hours)

-- Discuss the role and importance of inventory accuracy efforts

-- Describe the responsibilities for inventory accuracy at the following levels:
    Naval Supply Systems Command (NAVSUP)
    ICP
    Stock Point

-- Explain how the ICP reconciles its records with the Transaction Item Reporting (TIR) activities

-- Describe the four types of errors identified by the reconciliation of ICP and TIR activity records

-- Describe and provide examples of how quality levels are monitored for the following functional areas of a stock point:
    Incoming Transportation
    Material Movement
    Repairables Program
    Storage Operations
    Receipts
    Issues
    Material Delivery

-- Describe a sampling plan

-- Define category A and B errors.

-- Describe the following physical inventory functions:
    Location Survey
    Physical Inventory Counts
    Physical Inventory Adjustments
    Causative Research

Inventory Accuracy Guest Speaker (1 hour)

-- Naval Supply Center Oakland - Systems Integrity Division (Code 44) guest lecture

Just-in-Time (JIT)/Kanban Inventory Systems (1 hour)

-- Discuss the philosophy of a JIT inventory system

-- Describe the use of Kanban cards in the JIT system

-- Describe the benefits of JIT

-- Discuss the possible Navy applications of JIT systems

Week 10

Current Inventory Management Topics Seminar (4 hours)

-- This week should be devoted to discussion of current Inventory Management topics. Some sources of subjects include:

GAO, DOD and Navy audit findings
SPLICE/SPAR development
NAVSUP systems integrity problem areas
Alternate inventory management systems

The use of group reports and guest lecturers would certainly be beneficial to facilitate the learning process during this week.

APPENDIX F

SUPPLY SYSTEM OVERVIEW AND BASIC INVENTORY MANAGEMENT CONCEPTS

June 2nd, 1988

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SUPPLY SYSTEM OVERVIEW AND BASIC INVENTORY MANAGEMENT CONCEPTS

Introduction

This text is intended to serve as the Navy's primer for Inventory Management. The United States Navy is a large organization that includes submarines, surface ships, aircraft, missiles, supporting shore activities and approximately 700,000 military and 360,000 civilian personnel. The Navy's mission is to project power and to control the seas to insure the defense of the nation and keep merchant sea lanes open. The supply aspect of this mission consumes 50% to 65% of the Navy budget. Almost 900,000 line items are managed by Navy supply organizations and over $6 billion worth of material is stocked throughout the world. Supply support is a key contributor to the operational readiness of Naval forces. The efficient management of the Navy's material inventories is a crucial element of this supply support.

This chapter will equip the reader with a thorough understanding of the following elements of inventory management:

- The overall organization of the Department of Defense and the Navy supply and material distribution systems.
- The three level structure for maintenance and inventory.
- The basic inventory concepts, terminology and models.
- The important decision variables and measures of effectiveness used in inventory management.

Chapter 1 provides the perspective to understand the more complex aspects of Navy inventory management. Chapter 2 starts with the study of inventory management at the beginning of a major weapons system life cycle: with the provisioning process. Here both the process of integrated logistics support (ILS) and the models used to determine initial spares requirements are thoroughly discussed. Once the inventory management process is initiated via provisioning, Chapter 3 examines the Navy's wholesale supply system for secondary items from the aspect of requirements determination. Chapter 4 discusses inventory management at the retail levels. Finally, Chapter 5 shows the relationship of material budgeting to inventory management. This chapter describes material budgeting at both the inventory control points and the retail levels.

Supply System Overview, Concepts And Organization

To understand the DOD and Navy supply and material distribution systems, one must understand their organizational and functional responsibilities, DOD and Navy policies, some processing systems and procedures, and the people-computer partnership. The following section discusses inventory management from these perspectives while keeping sight of the fact that the purpose of the supply system is more than just to provide items of supply. Its purpose is to keep fleet weapons systems operating.

Supply Management

Supply Management is the segment of military logistics through which direction and control of all phases of supply operations are exercised. The elements of supply operations are:

- **Cataloging** - This entails the collection, storage and publication of all technical information regarding equipment and parts support for the Navy.
- **Identification** - Properly identifying systems, equipment and spare parts as they become Navy property.
- **Standardization** - The effort to procure standardized weapons systems for the Navy without compromising readiness.
- **Requirements determination** - Determining when and how much of each spare part to procure.
- **Procurement** - The act of purchasing material and equipment.
- **Inspection/Quality Control** - Ensuring the accuracy of Navy stock inventories and validating that procured material meets the highest standards for use.
- **Storage** - Ensuring the safe stowage of material prior to use by the customer.
- **Distribution** - The location of Navy material so that it is available for customer use when required.
- **Disposal** - This function provides for the proper removal from the Navy's inventories of an item of stock at the end of its useful service life.
- **Repair Management** - Arranging for the rebuild and restoration of economically repairable material.
- **Transportation** - Proper shipment of material to customers, repair activities, and inventories.
- **War Reserve Planning** - Participating in mobilization planning, industrial readiness planning and item management classification.

For the purpose of this text several of the above items will not be discussed in detail. They do provide some insight into the complexity of the Navy supply mission. The topics of cataloging, identification, standardization, and requirements determination will be addressed in some depth in this chapter.

Basic Inventory Management Terms and Definitions

End Item: An end item is defined as a "final combination of end products, component parts, and/or materials which is ready for its intended use." Examples would be ships, tanks, mobile machine shops and aircraft. End items are also capable of independent use and may be more simple in construction than the examples given above.

Principal Items: Principal items are end items which are specifically designated by the CNO as a principal item and are characterized by the following management and material considerations:

1. Requirements for the item are determined on a planned basis by the cognizant hardware systems command, rather than by the Naval Supply Systems Command.
2. Requirements for the item are based solely on planned end-use allowances and planned reserve/retention requirements.
3. Separate budgets are formulated through material planning studies and principal item stratifications.
4. Procurements are financed exclusively with appropriated or investment funds.
5. Disposal of items is based solely on major or total destruction, intended destructive use, (for example, the Trident missile), or planned retirement.
6. Issues to end-users are strictly limited to approved authorizations from the hardware systems command which manages the principal item.

Examples of principal items include radar, boiler and gun systems.

Secondary Items: Secondary items are those items not classified as principal items and which exhibit the following characteristics:

1. Requirements for the item are determined by the cognizant inventory control point.
2. Requirements for the item are based either on estimated or observed demands, or on non-demand based insurance levels.
3. Budget formulations are based upon standard levels-setting techniques and standard secondary item stratification projections.
4. Procurements are financed either with investment funds or stock funds, as governed by such factors as unit price and recoverability.
5. Disposal decisions are based primarily on normal in-service wear-out or consumption.

Examples of secondary items include gaskets, nuts and bolts and paper products. Basically, secondary items include a majority of consumables, repair parts and repairables.

One final note: The definitions above are subject to interpretation depending on the programs to which they apply.

Consumable Item: This is material which, after issue from stock to the final user, is consumed in use, or which, while having continuing life, becomes incorporated in other property, thus losing its identity when it is dropped from property accountability. Generally, consumable items are not repaired when unfit for further service. The consumable category excludes major components of equipment, such as aircraft engines, ship propeller shafts, and electronic "black boxes". Consumable items are sometimes referred to as expense items. Wholesale level inventory managers treat field level repairables as consumable items because they are repaired below the depot level.

Repairable Item: A repairable is an item of supply that can be made to function by a repair process after it breaks. It is also referred to as an investment item. Repairable items are usually the more expensive parts or components contained in Navy weapons and ships systems. Some examples include gear boxes, circuit boards and electronic "black boxes".

Cognizance Group: A cognizance group indicates the agency or office which exercises supply management over spare parts in all Navy systems. The cognizance group (cog) is indicated by a two digit character and is usually found preceding the material stock number. Additionally, an item's cog indicates what type of material is in that group. For example, the cog identifies whether the item is a consumable or repairable, its material characteristics, and even the funding source for the item. A cognizance group is

also a way of grouping like items for administrative and inventory management purposes. The term cognizance group is sometimes called cognizance of material.

Allowance Parts Lists (APLs): An effective supply system must use its knowledge of customers' technical requirements to prepare listings of the repair parts each customer will need to carry locally. In the Navy's supply system, these lists are called Allowance Parts Lists (APLs). An APL is a list of spares or repair parts. An APL is prepared for each shipboard equipment and system. The APLs for a particular ship are combined into a Coordinated Shipboard Allowance List (COSAL) or an Aviation Consolidated Allowance List (AVCAL) for aviation systems. The customer uses the material in the AVCAL and COSAL to maintain their equipment and to obtain information needed to requisition items.

Appropriated Purchases Account: This is the budgetary account in which material procured with appropriated funds is carried until expended by use or otherwise removed from the supply system. Currently, material purchased with this account is mainly limited to complex, costly, principal items.

Navy Stock Fund: This is a revolving type fund used to finance procurement of consumables and most repairables. When received for stock by Navy Stock Fund holders, material is picked up in the Navy Stock Account until sold to users.

Supply System Overview

The current structure of the supply system is best described in terms of its development. Prior to the 1960's, each of the services individually managed all of the material that the individual service required. This resulted in a great deal of duplicated effort in inventory management and maintenance. In the 1960's, DOD began to emphasize consolidation of inventory management functions. The first step was to remove from the servicesthe wholesale supply management responsibility for those consumable items that were also managed by the General Services Administration (GSA) and consolidate their management at GSA. The services now had to "buy" these items from GSA and to depend upon GSA to properly manage the inventories of these general consumable items. Some examples of GSA managed items include office products and furniture.

The next step in the process of consolidation was the creation of the Defense Logistics Agency. DLA was given the responsibility for managing those consumable items which were peculiar to the military but which were used by more than one service. An additional criterion for DLA management of an item was that the material had to be relatively easy to manage, that is, of stable design and easy to procure. Finally, the relatively few consumable items left under the control of the services were further consolidated so that any item which was used by two or more of the services would be managed by only one service.

These changes represent a supply management technique called integrated management. Integrated management is a technique through which responsibility for the wholesale level management of an item of supply is assigned to a single government agency or military service inventory manager for the purpose of supporting the requirements of all military services. For example, the Defense Personnel Support Center (DPSC) centrally procures or manufactures and manages the clothing and uniform needs of the various services.

The objective of this integrated management policy is to eliminate the duplication of item management activities. There will be only one inventory control point for any item used in the Department of Defense. In general, the military services should manage the weapons systems, including ammunition, principal items of equipment, depot level repairables and items of a developmental nature, regardless of the number of user services. Items which are repaired below depot level, consumables, and repair parts should be considered for integrated management.

Stock Coordination

Stock coordination ties in with integrated management policy. Stock coordination is the administrative process by which an item, group or category of material is identified and assigned to one inventory manager. The purpose of this process is to sustain the proper application of item management on a continuous basis. The process begins with the approval for the establishment of a major weapon or weapon support system and continues until the weapon or system is taken out of operation. From the time that the initial determination and assignment of material cognizance group is made, the characteristics of the item, its parent equipment, and the environment of operations will be continually reviewed to insure that all items will be managed at the most logical and appropriate level. Stock coordination is required on a Navy-wide basis to ensure that the interrelated actions of hardware systems commands and program managers are mutually responsive and integrated. The key hardware systems commands (HSCs) involved with this stock coordination effort are the Naval Sea Systems (NAVSEA), Naval Air Systems (NAVAIR), Naval Facilities Engineering (NAVFAC), Naval Space and Warfare Systems (SPAWARS), and Naval Supply Systems (NAVSUP) commands. Stock coordination reviews can lead to inventory management transfers from the systems commands to the service inventory control points (ICPs) to DLA management. Infrequently, items will migrate in the opposite direction.

During past years there have been massive changes in inventory management through stock coordination actions. The impacts of these changes have affected the end strength of our ICPs, the relative sizes of Navy and DLA stock funds and other areas. Figure 1 illustrates the impact of these changes. The bulleted items under the pie charts in the figure describe some of the key historical stock coordination actions.

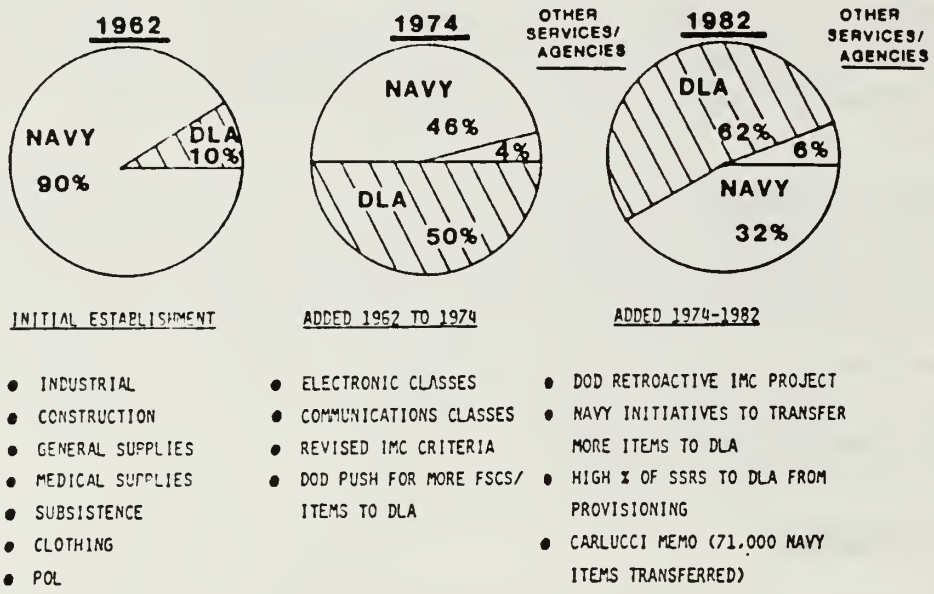

Figure 1. **Changes in Management of Items:** Source - Career Supply Management Course Technical Notes, 1985.

Standardization

Material standardization is a DOD policy and goal. The purposes of material standardization are to improve the efficiency and effectiveness of logistic support and operational readiness; and to conserve money, manpower, time, production facilities and natural resources without compromising the suitability of the material. All of the elements of Integrated Logistic Support (ILS) tend to be favorably affected by standardization and unfavorably affected by lack of standardization. The hardware systems commands are charged with the responsibility for the development of detailed plans, schedules, and procedures for implementation of the Defense Standardization Program within the Department of the Navy. DOD instruction 4120.3 provides the objectives of the standardization program as follows:

1. Adoption of the minimum number of sizes, kinds or types of items and services essential to military operations.

2. Achievement of the optimum degree of interchangeability of the component parts used in these items.

3. Development of standard terminology, codes and drawing practices to achieve common understanding and clear interpretation of the description of items and practices.

4. Preparation of engineering and purchase documents to ensure the design, purchase and delivery of items consistent with the technical requirements of the item and the scope and purpose of the standardization program.

5. Enhance reliability and maintainability of military equipment and supplies by the selection of material which has been evaluated in accordance with Government specifications and standards.

Components equipments that require spare parts support will be acquired in a manner which is oriented toward replacement in kind (same make and model) so as to enhance standardization and obviate the preparation of new allowance lists or adjustment of repair parts distribution. The applicable logistic support costs, or total cost to the Government, will be considered before acquiring other than a make or model used in previous Naval systems, listed on existing allowance lists, and supported by the supply system.

Historically, Navy attempts at standardization have not met with great success particularly in the hull, mechanical and electrical (HM&E) areas. Frequently, the procurement regulations make standardization more difficult to achieve. Additionally, the way we have procured ships with contractor (shipbuilder) furnished HM&E equipment has led to lack of standardization. The best solution for this problem is to write ship contracts with incentives for equipment and parts standardization. NAVMAT instruction 4120.97 provides these types of guidelines for supporting standardization practices in Navy procurements.

The impact that use or lack of standardization can have on supply, maintenance, technical manuals and other ILS elements is tremendous. Figure 2 illustrates how previous shortfalls in equipment standardization have led to enormous deficiencies in parts commonality.

COMMON SHIPS	NUMBER OF COMPONENTS	% OF TOTAL	CUMULATIVE PERCENTAGE
1	40,331	25.76	25.76
2	25,167	16.08	41.84
3	15,508	9.90	51.74
4	10,463	6.68	58.42
5	8,763	5.60	64.02
6	6,232	3.98	68.00
7	4,411	2.82	70.82
8	3,757	2.40	73.22
9	3,077	1.97	75.19
10-19	16,397	10.47	85.66
20-49	14,178	9.06	94.72
50-99	4,644	2.97	97.69
100+	3,617	2.31	100.00
TOTAL	156,545	100.00	

Figure 2. Commonality of HM&E APLs in the Fleet: Source - Career Supply Management Course Technical Notes, 1985.

Cataloging

Cataloging (assigning National Stock Numbers), for most people, is not an exciting subject yet it is one of the most critical areas affecting supply support. The goals of cataloging are to increase military effectiveness, aid the national economy, and promote greater efficiency and economy in material logistics operations. NAVSUP has the responsibility to develop policy, detailed plans, schedules and procedures for implementation of the Federal Catalog Program with respect to Navy material.

The objectives of the Federal Catalog Program as stated in the Defense Logistics Service Center publication entitled, *Overview of the Federal Catalog System,* are:

1. To develop, establish and maintain a single uniform catalog system, and thereafter use this system as an effective tool of management in all material logistics functions.
2. To provide a common identification language, eliminate different identifications of like items, aid in standardization, facilitate inter- and intra-departmental logistic support, assist industrial mobilization, prevent unnecessary new items from entering the supply system and strengthen government-industry relationships.

There are three basic ingredients to a cataloging system:

- Stock Number
- Classification
- Publication Communication

Establishment of a unique identification number (the National Stock Number (NSN)) for an item of supply is the most important element of a cataloging system. The assignment of an NSN converts the various part numbers assigned by civilian defense contractors to a common numbering system for use by DOD. It is through the assignment of National Stock Numbers that the DOD and Navy are able to carry out many of their supply policies such as parts standardization, interchangeability, integrated management and others. The use of uniform commodity groupings to systematically categorize related items of supply is the key to classification (eg. commodity group 5130 - Power Driven Hand Tools). Finally, the publication and communication of the cataloged data is necessary to provide rules and reference materials and to display the data

on file.

The Defense Logistics Services Center (DLSC), in Battle Creek, Michigan, is the keeper of all cataloging data. DLSC assigns all NSNs, maintains a data bank of information on all NSNs through the Defense Integrated Data System (DIDS) and provides logistics services from the DIDS to all military activities, Federal civil agencies, participating foreign governments and private industry. The basic steps in the cataloging process are:

1. Select maintenance significant parts as identified by the manufacturer.
2. Provisioning packages for new equipment are screened to find parts which already have stock numbers assigned.
3. Assignment of Item Management Codes (IMCs). These codes determine whether the items will be Navy or DLA managed. If the item passes through all the filter screens illustrated in Figure 3 it will be managed by DLA.
4. Assign stock numbers as required.
5. Supply Support Requests (SSRs) for part numbered items which will be managed by DLA are forwarded by the using service to the proper DLA inventory manager to obtain supply support. A SSR for items with stock numbers already assigned is forwarded to alert him of Navy requirements for new and follow-on provisioning.

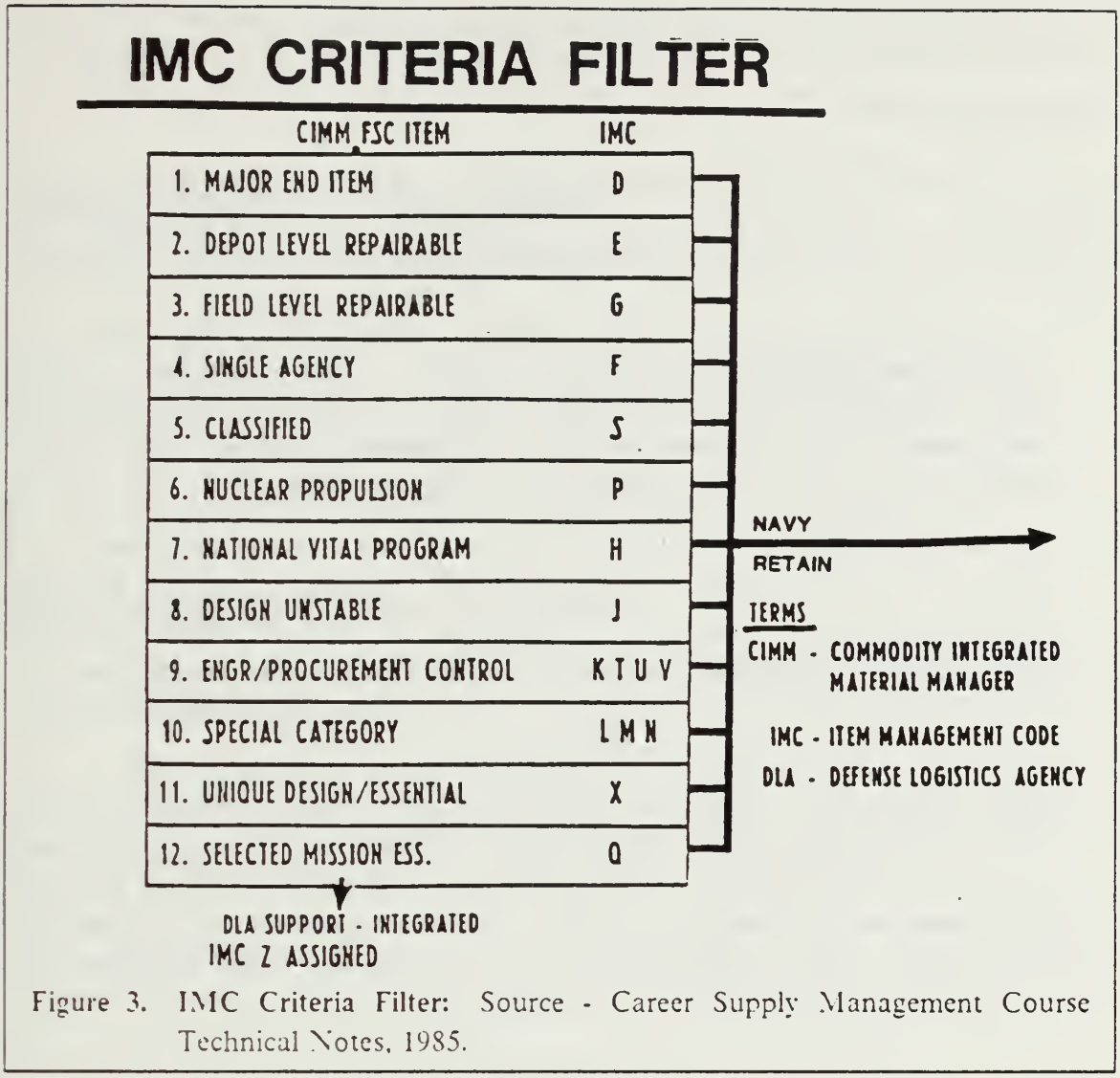

Figure 3. IMC Criteria Filter: Source - Career Supply Management Course Technical Notes, 1985.

Currently, about 80 per cent of all newly provisioned items are being assigned to DLA for management. The majority of the items being retained for Navy management are repairables. This statistic is a clear indication of the current policy to give as many of the consumable items as possible to DLA.

Levels of Maintenance and Inventory

Maintenance and inventory functions are closely related and must be clearly understood

before describing inventory theory and management approaches.

Maintenance Levels

The three general levels of maintenance used in the Navy are: organizational, intermediate and depot. The Navy may use their own internal capabilities for all three levels of maintenance or may have contractors perform this work. Organic Navy capabilities typically consist of:

- **Organizational Maintenance** - Shipboard, squadron, station and mobile technical units. Maintenance at this level is normally limited to periodic checks of equipment performance, visual inspections, cleaning of equipment, some servicing, external adjustments, and the removal and replacement of some components.
- **Intermediate Maintenance** - Aviation Intermediate Maintenance Departments for Marine Air Groups or Naval Air Stations, tenders and repair ships for ships and submarines, and Shore Intermediate Maintenance Activities for non-aviation fleet units. At this level, end items may be repaired by the removal and replacement of major modules, assemblies, or piece parts. Scheduled maintenance requiring equipment disassembly may also be accomplished.
- **Depot Maintenance** - Naval Air Depots (NADEP), Naval Shipyards, weapons stations, weapon centers and Naval Ordnance Stations. This is the highest, most complex level of maintenance. The depot level of maintenance includes the complete overhauling, rebuilding and calibration of equipment as well as the performance of highly complex maintenance actions. Of all the levels of maintenance, this level makes the greatest use of contractor services.

Inventory Levels

Inventories are maintained to support two functions: peacetime operations and providing an adequate supply of war reserve material. The three levels of peacetime inventory are called wholesale, retail intermediate and retail consumer. Peacetime Operating Stock (POS) as defined by DOD Directive 4140.1 is simply material designated to meet peacetime force material requirements. The levels of inventory are defined as follows:

- **Wholesale Inventory** - Material over which the wholesale inventory manager has visibility and control at the national level. The management of Wholesale inventories in the Navy is discussed in Chapter 2 (Provisioning) and Chapter 3 (Requirements Determination).
- **Retail Intermediate Inventory** - A level of inventory between the consumer and wholesale levels to support a given geographic area, including area resupply and the three levels of maintenance. The management of the retail intermediate level of stock is discussed in Chapter 4.

- **Retail Consumer Inventory** - This level of inventory is material held strictly for a specific unit's own use. Initial provisioning for specific units is described in Chapter 2. The replenishment of these stocks is described in Chapter 4.

General Characteristics of Wholesale Inventories

1. Inventory levels are computed based on worldwide demand data.
2. Material is available for unrestricted use by the wholesale item manager.
3. The wholesale item manager knows (theoretically) where all stock is located.
4. Material is under the accountability of the designated inventory control point.
5. Material is "pushed" by the wholesale level to the retail intermediate level.

General Characteristics of Intermediate Inventories

1. Requirements are computed based on historical demands arising in a geographical area or from designated activities.
2. Material is "pulled" from the wholesale system. (This is presently true only for material which is managed at the wholesale level by DLA, GSA or another service.)
3. Each transaction concerning an item is reported to the wholesale level.
4. The stock is not usually available to satisfy demands outside the stock point's geographical area of support.

General Characteristics of Consumer Inventories

1. The purpose is to provide direct support associated with readiness goals.
2. Computations are made to set up inventories via an allowance list. These allowance lists are established to meet operational readiness goals based on specific unit endurance goals.
3. Material is issued directly to the maintenance technician.
4. Inventories are not used to resupply another level of inventory.
5. The material is used by the activity in performing its function.

War Reserve Material

In actuality, a fourth level of inventory exists. In addition to peacetime operating stock (POS) levels, the Services are required to determine and maintain war reserve requirements as an essential part of a credible conventional deterrent. The following definitions apply to war reserve material:

- **War Material Requirement (WMR)** - The total material needed to sustain mobilization operations during the period prescribed by DOD for war material planning purposes.
- **War Reserve Material Requirement (WRMR)** - That portion of the WMR that must be physically on-hand on D-day. A portion of the WMR can be purchased from American industry so quickly that it does not have to be stocked in military inventories.
- **Prepositioned War Reserve Material Requirement (PWRMR)** - That portion of the WRMR that must be reserved and actually positioned at or near the point of planned use or issue to support operations until replenishment can be provided.

The determination of war reserve requirements is discussed in Chapter 5. DOD Directive 4140.2 and DOD Instruction 4140.47 give specific policy and procedures governing war reserve requirements determination.

Defense Logistics Agency (DLA) Organization

Scope

Not only does DLA manage 54 percent of all stock numbered items for all DOD, but of the 2,138,000 NSN's used throughout the Navy, 66 percent of those items are presently procured and managed at the wholesale level by DLA. Only 27 percent are Navy managed, while 7 percent are managed by GSA or another service. Figure 4 graphically illustrates the key role DLA plays in inventory management by showing the percentages and quantities of stock numbered items managed by DLA and the individual services.

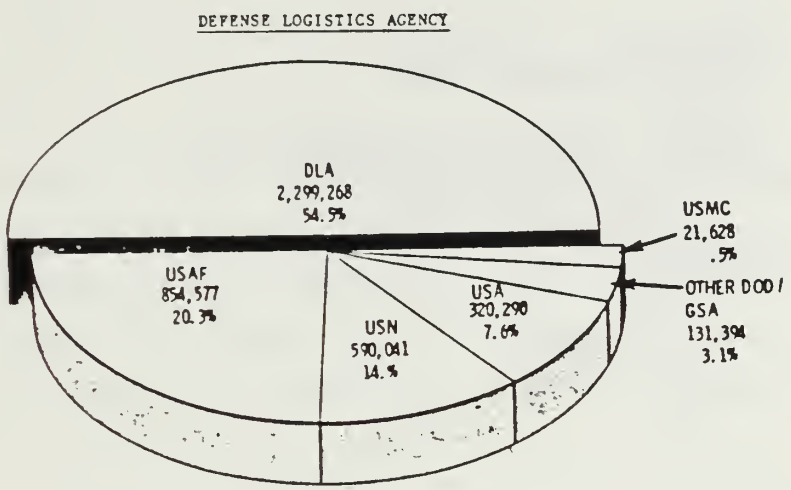

Figure 4. National Stock Number Management: Source - Career Supply Management Course Technical Notes, 1985.

DLA Mission

The mission of DLA is to enhance the material readiness of the Armed Services and contribute to the operating efficiency of the Department of Defense by providing effective and economical support for assigned:

- Items of supply
- Logistics services
- Contract administrative services

DLA functions are executed through various supply centers, depots, contract administration services regions and service centers throughout the country. Figure 5 shows the basic DLA organization.

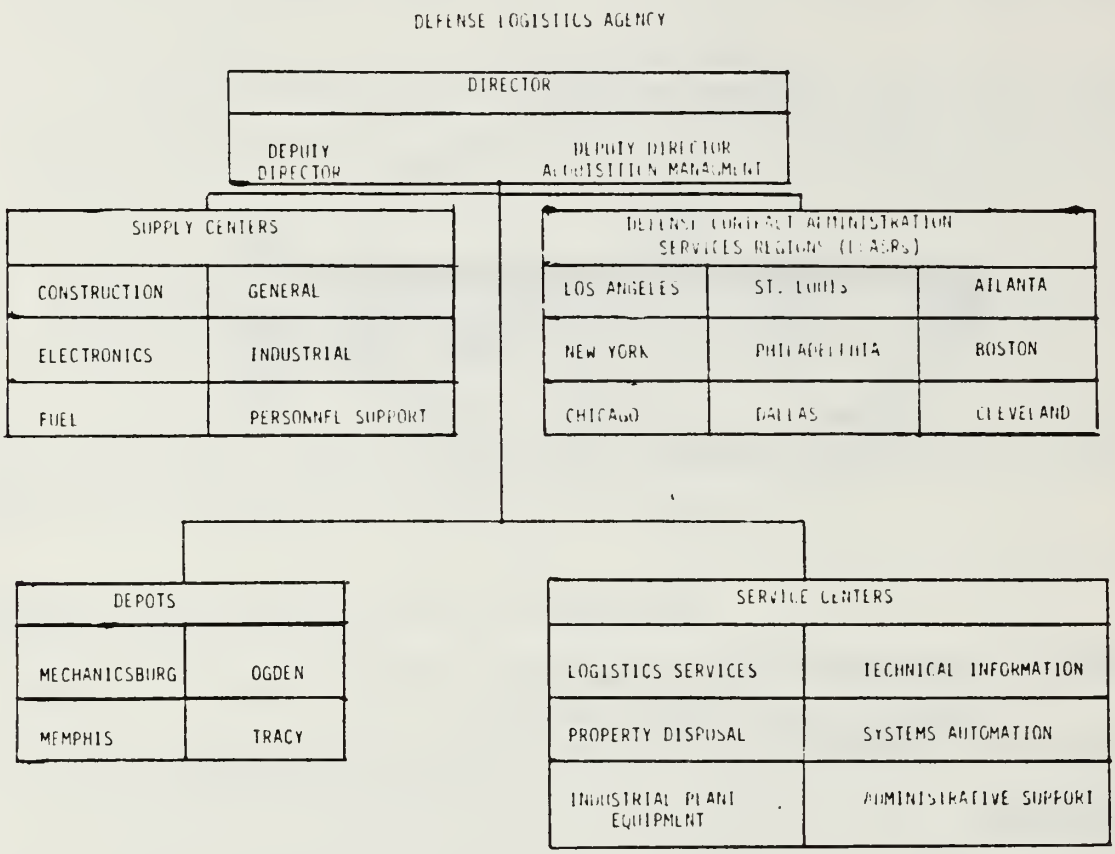

Figure 5. Defense Logistics Agency Organization: Source - Career Supply Management Course Technical Notes, 1985.

DLA Supply Centers

The six DLA Supply Centers shown in Figure 6 are more analogous to the Navy inventory control points than to a Naval supply center. The DLA supply centers are primarily wholesale level organizations.

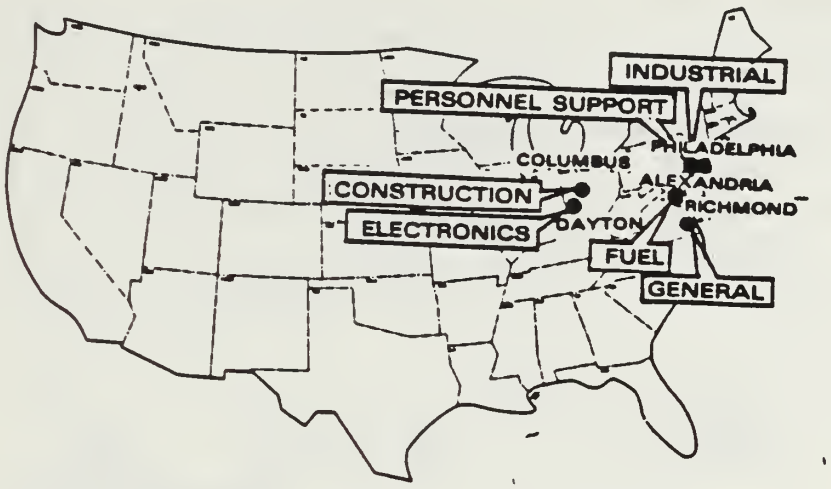

Figure 6. DLA Supply Centers: Source - Career Supply Management Course Technical Notes, 1985.

DLA supply centers perform the following functions:

- Computing wholesale requirements for assigned items.
- Procuring items for stock and direct delivery to customers.
- Processing requisitions and maintain accountibility records.
- Performing value engineering and item standardization studies.
- Developing acquisition data packages.
- Developing item identification and catalog management data.
- Reviewing inactive items.
- Expediting Fleet and other service requirements.

During FY86 the DLA supply centers initiated 1.5 million contractual actions and obligated 16 billion dollars in order to purchase required DOD material. This is well over twice the combined dollar value of the Navy inventory control point (ICP) business. The commodities and items managed by DLA tend to be "easier" to manage than do most Navy managed items. However, the Navy ICPs are rapidly turning over to DLA all but a few categories of consumable items. In the future, this will mean that DLA will have an even more direct affect upon fleet support.

DLA Distribution System

The DLA distribution centers received over 7.5 million requisitions during FY86. Major DLA distribution points are at Tracy CA, Ogden UT, Columbus OH, Mechanicsburg PA, Memphis TN and Richmond VA. Naval supply centers are also major specialized support points (SSPs) which means that they stock wholesale DLA material. NSC Norfolk, for example, will issue DLA material worldwide to Army and Air Force commands as well as to Navy requisitioners. Figure 7 displays the DLA distribution system.

Figure 7. DLA Distribution System: Source - Career Supply Management Course Technical Notes, 1985.

DLA Service Centers

In addition to inventory management and material distribution, DLA performs various technical and logistics services for all the services as an agent of the Department of Defense. These services include maintaining the Federal catalog system, managing the excess defense property disposal program, managing industrial plant equipment and maintaining DOD scientific and technical information. Figure 8 shows these services and their locations.

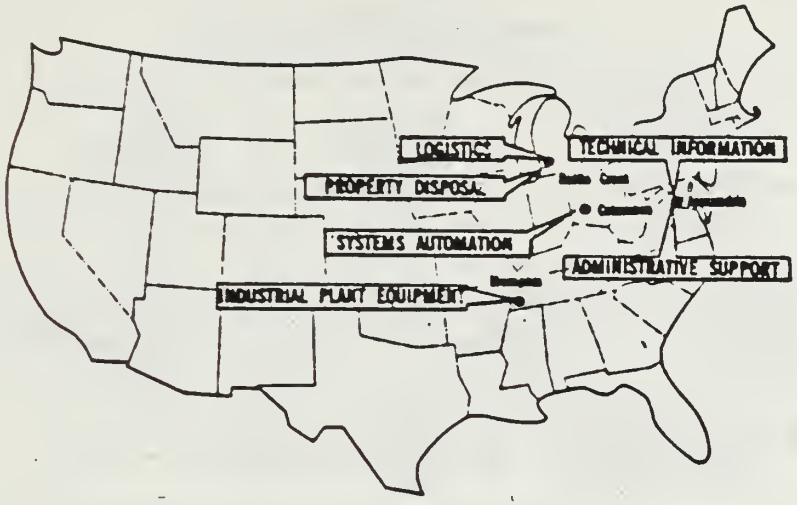

Figure 8. **DLA Service Centers:** Source - Career Supply Management Course Technical Notes, 1985.

DLA Contract Administration

Contract administration services are another major DLA function. To perform its contract administration functions, DLA splits the country into nine geographic regions. A Defense Contract Administration Region (DCASR) and its field commands serve the region. DLA assumes responsibility for the administration of a majority of DOD contracts following initial procurement action by the services. Figure 9 demonstrates the scope of this important function.

DLA WORKLOAD
(CONTRACT ADMINISTRATION)
AS OF 2ND QTR FY 1984

PRIME CONTRACTS SERVICE/AGENCY	NO. OF CONTRACTS ADMINISTERED BY DCAS (THOUSANDS)	VALUE OF CONTRACTS ADMINISTERED BY DCAS ($ BILLIONS)
AIR FORCE	80.4	40.7
ARMY	42.4	59.9
NAVY/USMC	99.9	63.2
DLA	73.9	5.7
OTHER	2.2	1.1
TOTAL PRIME CONTRACTS	298.9	170.7
SUPPORT CONTRACTS	11.3	
TOTAL PRIME AND SUPPORT CONTRACTS	310.2	

Figure 9. DLA Contract Administration Workload: Source - Career Supply Management Course Technical Notes, 1985.

Navy Supply System Organization

To understand inventory management in the Navy it is necessary to be thoroughly familiar with the organization of the Navy's supply system. Basic supply support is derived from several sources: the internal Navy supply system; DLA; other military services; and the GSA. Figure 10 illustrates this organization. The following section on the the Navy's supply system identifies and provides a brief summary of the key organizations.

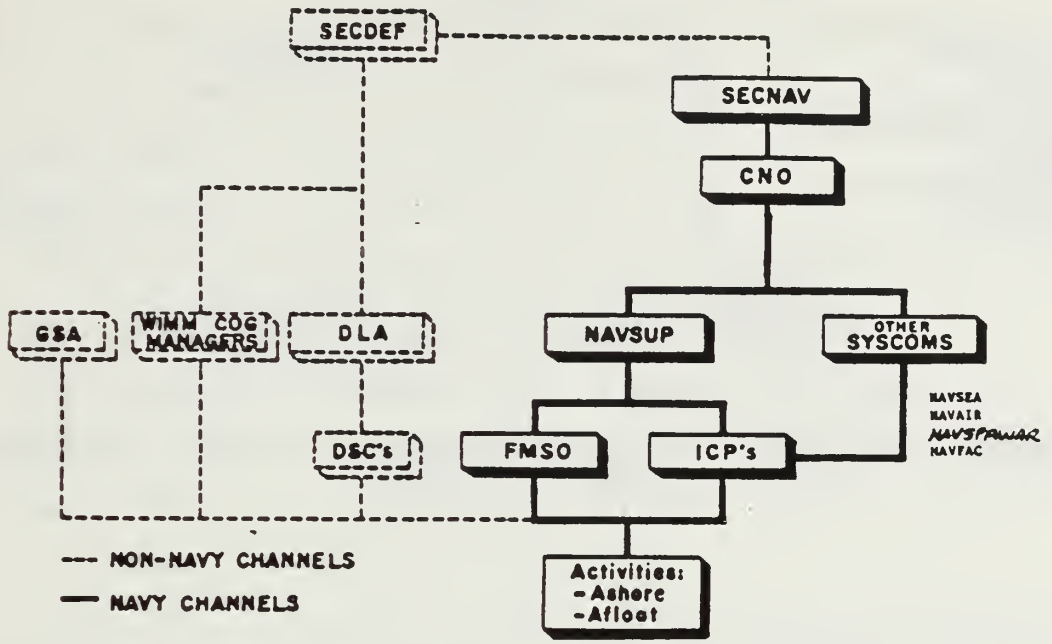

Figure 10. The Navy Organization for Supply: Source - FMSO Basic Inventory Manager's Manual.

Naval Supply Systems Command (NAVSUP)

NAVSUP has a number of broad management responsibilities. Some of the major responsibilities include:

- Inventory management of all parts in a principal end item from the time of the Navy support date in the life cycle, to final disposal of the last unit.
- Central weapons configuration data.
- Program support for DLA and other non-Navy managed items.
- Automated data processing systems.

The Commander of the Naval Supply Systems Command, assisted by his headquarters staff is responsible for policy direction and guidance in these areas. The major commands which execute the Navy supply management functions are the inventory control points (Ships Parts Control Center and Aviation Supply Office), 43 retail intermediate stock points, the Fleet Material Support Office and the Publications and Forms Center. The NAVSUP organization is shown in Figure 11.

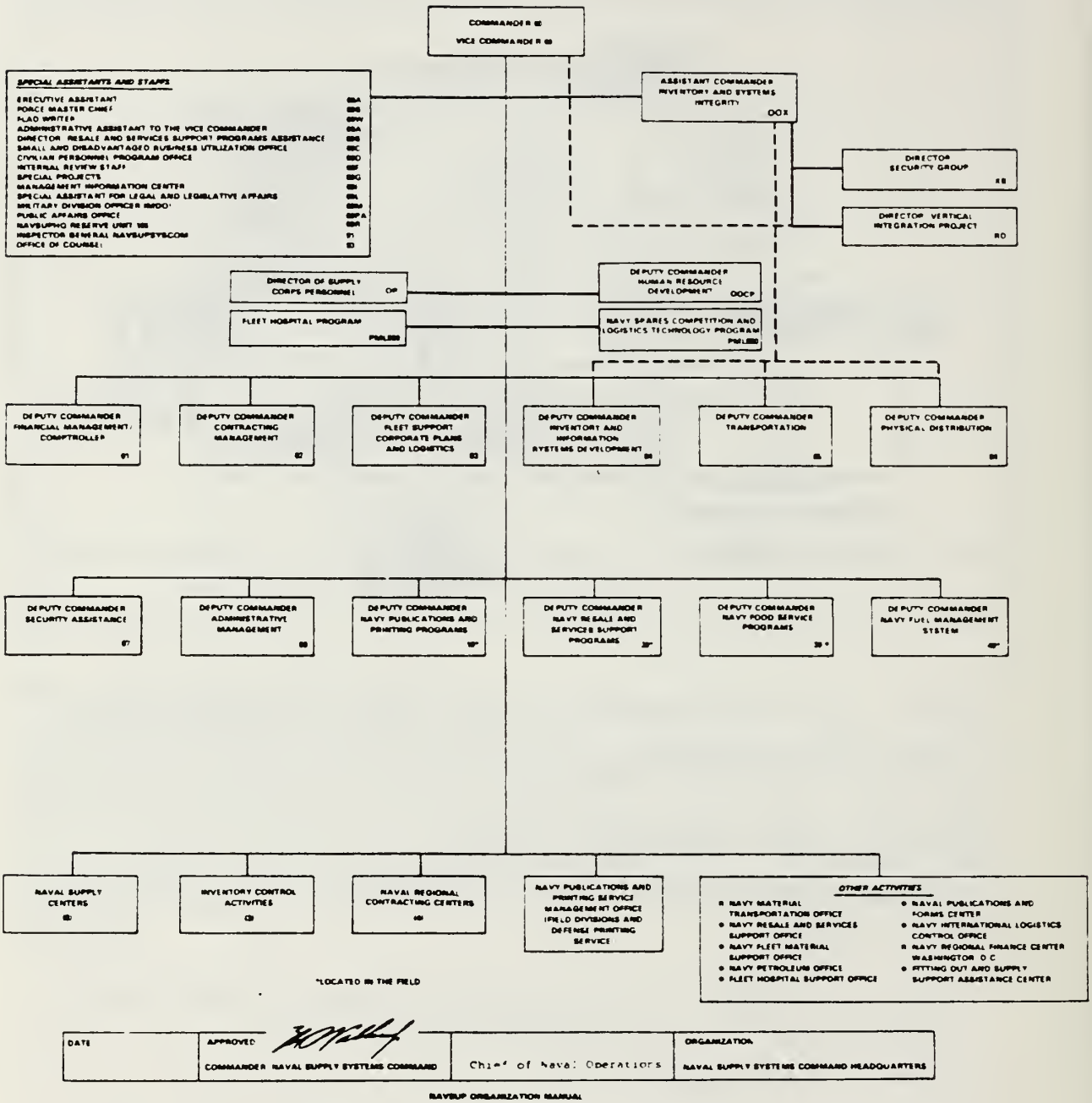

Figure 11. Naval Supply Systems Command Organization: Source - NAVSUP Organization Manual, 1987.

Navy Supply Management Organizations

The key commands in the Navy's supply management organization along with their primary responsibilities are listed below:

- Inventory Control Points (ICPs)
  - ICPs control 480,000 line items at SPCC and 370,000 at ASO.
  - ICPs manage weapons system configuration.
- Fleet Material Support Office (FMSO)
  - FMSO finances 1,500,000 line items.
  - FMSO maintains 10,000 computer programs.
- Navy Stock Points (43 located throughout the world)
  - Stock points collectively stock 2.5 million line items.
  - Stock points have a collective inventory value of $12 billion.
- Navy Publications and Forms Center (NPFC)
  - NPFC controls 250,000 line items.
  - NPFC maintains a central warehouse for publications and forms and is developing a "print on demand" capability.
  - NPFC stores and issues Navy required publications and forms.

Functions of an Inventory Control Point (ICP)

Most ICP functions can be categorized into two broad areas: program support and supply support. Program support functions relate to the total support of weapons systems. For instance, a question about general support of the F/A-18 aircraft will be answered by a weapons systems (program support) manager who will collect and analyze information from the ASO and DLA item managers who are responsible for managing the components and parts of the F/A-18. Supply support functions deal with items managed by the ICP. Supply support involves item management, e.g., requirements determination, material distribution and procurement of replenishment stock, repairables management, disposal, etc. Program support managers have more external dealings than supply support managers with the hardware systems commands, engineering activities, and other weapons systems ILS managers. Supply support functions tend to deal with supply centers, material requisitions at all levels, depot level component repair activities and program managers in the ICPs (particularly their own ICP) who are either

looking for information or providing information about an item of equipment.

The following lists distinguish the differences in the roles of the ICPs for program and supply support:

ICP Program Support Functions

- Life cycle weapons support which entails management of most of the logistics elements of the system
- Provisioning
- Allowance and load lists determination
- Maintaining configuration files
- Writing supply support requests (SSRs)
- Determining replacement or failure rates for spare parts
- Analysis of weapons system performance

ICP Supply Support Functions

- Integrated inventory management
- Requirements determination
- Material distribution and issue
- Material procurement
- Repairables management
- Budget development for parts support

Figure 12 helps illustrate the difference in program support versus supply support ICPs. In this example, SPCC is the central point of contact for all support problems for this diesel boat engine. If a type commander such as SURFLANT is unhappy with diesel engine support, he turns to SPCC as the Program Support ICP (PSICP) to fix the problem. SPCC, as the supply support ICP manages only 63 of the 701 items but, as the program support ICP will, as required, deal with all the other cognizant inventory managers, the engineers and maintenance activities, adjust allowance and load lists, or take whatever actions are necessary to improve supply support. The figure illustrates how a wide variety of ICPs may exercise management control over the various parts of a system. For example, the Army's Tank and Automotive Command (TACOM) controls 14 items of supply for the diesel engines.

PROGRAM SUPPORT
VS
SUPPLY SUPPORT

6V53N DETROIT DIESEL ENGINE
APPLICATION—SMALL BOATS APL 666010201

COG	MANAGER	ITEMS ON APL
1H	SPCC	61
7H	SPCC	2
9Q	GSA	64
9A	TACOM	14
9C	DCSC	340
9G	DGSC	17
9N	DESC	2
9Z	DISC	201
	TOTAL	701

Figure 12. Program versus Supply Support: Source - SPCC Command Business Presentation.

The ICPs have always had a program support responsibility. However, in recent years, weapons systems support responsibility has become more visible, more critical and more recognized at both the PSICPs.

Functions of a Stock Point

The main mission of a stock point is the physical distribution of material. Timeliness and accountability are two key performance indicators for this mission. The main functions include:

- Receiving material
- Stowing material
- Issuing and shipping material
- Billing the customer for material
- Budgeting and accounting for funds to procure material
- Reporting receipts and issues to each item's ICP

Functions of the Fleet Material Support Office

The Navy Fleet Material Support Office, more commonly referred to as FMSO, is a unique command within the Navy supply system. FMSO is widely known throughout the supply system but probably not fully understood in terms of its complete range of mission responsibilities. This is due to the diverse range of FMSO's activities and to the largely supporting nature of those activities. FMSO's mission areas focus on the following five functions:

- Central design agency (CDA) for the computer software used at the ICPS and stock points.
- Retail Navy stock fund (NSF) management.
- Operations analysis, i.e. design of supply models and procedures
- Supply operations support.
- International logistics.

Central Design Agency (CDA): As the Navy supply system's central design agency, FMSO is responsible for providing the computer network of the supply system with the computer programs necessary to allow the hardware to operate. The CDA mission of FMSO is its largest mission, with about 80 per cent of its work force of 1300 engaged in CDA related activities. A significant portion of that effort is deals with four uniform (standardized) automated data processing (ADP) systems; the uniform ADP system for inventory control points (UICP), the uniform ADP system for large stock points (UADPS-SP), the Level II/III system for small aviation stock points and the disk oriented supply system (DOSS) for the smallest stock points.

As their names suggest, the first two of these four systems are used by the ICPs and stock points to perform their respective supply, accounting, and financial management functions. The Level II/III systems are in use at several of the Navy's smaller aviation support facilities for the purposes of supply, financial, and resources management. The last of the four uniform systems, DOSS, is used by the smaller stock points and is a scaled down version of the UADPS-SP employed by the larger stock points.

The headquarters financial information system maintained by FMSO is another major CDA effort for FMSO. These systems are used to help manage major investment appropriations such as ship's construction and aircraft procurement funds, operations and maintenance funds, and research, development, test and evaluation funds. Similarly, the Management Information System for International Logistics, known as MISIL, is yet another information system maintained by FMSO. The MISIL system is used by the Navy International Logistics Office in Philadelphia to process material requisitions from foreign navies.

A special project sponsored by NAVSUP has recently been receiving a great deal of attention by FMSO. This project is the "resolicitation" effort whose purpose is to identify and acquire the computer necessary to serve the needs of the two ICPs in the 1980s and beyond. This project has resulted in the installation of new IBM mainframe computers at the ICPs, thereby correcting some of the recent problems connected with the overloading of the previous hardware. FMSO is also writing much of the new software that will capitalize on the improved capabilities of the new computers. This effort to increase the efficiency of the ICPs through improvements in software is called "resystemization".

Retail Navy Stock Fund Manager: FMSO is the supply system's central manager for the $3 billion plus stock point portion of the retail Navy stock fund. The fund is used by the stock points to finance the procurement of the items under the wholesale management of non-Navy activities such as DLA or GSA.

Operations Analysis: FMSO's operations analysis mission involves a multitude of functions. The Operations Analysis Department within FMSO conducts analyses in logistics management using various mathematical, statistical and economic analysis techniques. For example, FMSO estimated the economic cost to the Navy of transitioning from the fleet logistics support improvement program (FLSIP) to the modified FLSIP (MOD-FLSIP) allowances and going from a two ocean, fleet item load list (FILL) to a single FILL. They provide both management alternatives and the associated cost benefit analyses to Navy decision makers.

Supply Operations Support: The supply operations support mission involves development of supply catalogs, the defective material reporting system, prepositioned war reserve interrogation and readiness reporting system and change notice processing. For example, FMSO compiles and distributes the afloat shopping guide (ASG).

International Logistics: The international logistics mission includes developing standardized supply procedures, on-site assistance and automation of supply systems for allied military services.

BASIC INVENTORY THEORY, TERMINOLOGY AND MODELS

Introduction

The chapters that follow this chapter will present the detailed models that the Navy uses to manage the various levels of inventories it owns. The following section introduces some of the basic terminology and theory on which the actual models are based. Additionally, this section will illustrate the conventional reasons for and costs of owning in-

ventory, along with the unique purposes associated with military inventory management. The basic inventory theory presented in the following sections is derived largely from Richard J. Tersine's book entitled Principles of Inventory and Materials Management.

Functions of Inventory

The existence of inventories can be explained by four functional factors:

- Time
- Decoupling
- Uncertainty
- Economy

Time Factor: The time factor involves the long process of production and distribution required before goods reach the final consumer. Time is required to develop the production schedule, make raw material requisitions, ship raw material from suppliers (transit time), inspect raw materials, produce the product, and ship the product to the wholesaler or consumer (transit time). Few consumers would be willing to wait for such an extended period of time on all their purchases. Keeping inventories enables a supplying organization to reduce the lead time in meeting demand.

Decoupling Factor: Decoupling allows the treatment of various dependent operations (retailing, distribution, warehousing, manufacturing and purchasing) in an independent and economical manner. Inventories make it unnecessary to gear production directly to consumption. Inventories free one stage in the supply-production-distribution process from the next, permitting each to operate more economically. The decoupling function permits the firm to schedule many operations at a more desirable performance level than if they were integrated dependently.

Uncertainty Factor: This factor concerns unforeseen events that modify the original plans of the organization. It includes errors in demand estimates, variable production yields, equipment breakdowns, strikes, acts of God, shipping delays, and unusual weather conditions. When inventory is available, the organization has some protection from unanticipated or unplanned occurrences.

Economy Factor: This permits the organization to take advantage of cost reducing alternatives. It enables an organization to purchase or produce items in economic quantities. Bulk purchases with quantity discounts can reduce procurement costs significantly. Per unit costs can be excessive if items are ordered separately without regard to transportation and lot size economies.

The four factors just described are the classic reasons that commercial organizations maintain inventories. These inventory functions are all valid for military organizations,

but the primary purpose for providing military inventories is to provide supply support to the fighting units of the fleets. The key element of this goal is clearly the objective of attaining a high level of operational readiness in all equipment necessary for ship's mission. The point to be made here is that, at times, the Navy's goal of maximizing operational readiness may be at odds with the classic inventory management goals of minimizing costs.

The Nature of an Inventory Problem

The nature of an inventory problem can be classified in many ways. It can be classified according to the repetitiveness of the inventory decision, the source of supply, the knowledge about future demand, the knowledge of the lead time and the type of inventory system. The usual forms of each classification are listed below:

1. Repetitiveness
   a. Single order
   b. Repeat order
2. Supply source
   a. Outside supply
   b. Inside supply (manufacture)
3. Knowledge of future demand
   a. Constant demand
   b. Variable demand
4. Knowledge of lead time
   a. Constant lead time
   b. Variable lead time
5. Type of review of the inventory position
   a. Continuous review
   b. Periodic review
6. Specific replenishment process
   a. Q system
   b. Min-max system
   c. P system
   d. T, R, M system
   e. Material requirements planning (MRP)

There are other ways of subdividing the inventory problem, but the classifications given above indicate the major dimensions of the problems that can be encountered.

To help solve the problems of inventory, it is necessary to build mathematical models which describe the inventory situation. Since it is never possible to represent the real

world with total accuracy, approximations and simplifications must be made during the model-building process. These deviations from reality are necessary for the practical reasons that:

- It is impossible to determine exactly what the real world is really (or will be) like.
- A very close approximation of reality would be mathematically intractable.
- Extremely accurate models can be so expensive that their final benefit does not justify the cost of building, maintaining and running the model.

The relevance of a model to a given situation must be based on the reasonableness of its assumptions and limitations. Additionally, a model must be targeted to achieve some measure(s) of effectiveness (MOE). Some examples of MOEs that are frequently used by the Navy include:

- Total cost
- System material availability (SMA)
- Net and gross availability
- Manpower constraints
- Storage constraints
- System operational availability (A_o)

The Navy's use of measures of effectiveness to evaluate supply system performance are discussed in a later section.

Inventory Decisions and Operating Doctrine

The basic questions that every inventory manager must address are:

1. How much to order, repair or produce (reorder quantity - Q)?
2. When to order, repair or produce (reorder point - R)?
3. Where to repair material?
4. Where to store the inventory?

In addition, there are several important questions which must be answered when setting up or modifying the inventory management system itself:

1. How will forecasting be done?
2. Which specific inventory model will be used?
3. When will the inventory position be reviewed (continuous or periodic) to see if the reorder point has been reached?

4. What specific information and computer systems will be used to assist the inventory management process?

5. What specific facilities will be used to store, repair and tranship inventory?

6. What people and organizational structure will be used to store, repair, ship and manage the inventories?

In the classical intuitive description of the problem, to the inventory manager with no constraints on resources, the question of how much to buy is simply a matter of the customer service level desired. The manager, without any constraints on resources, can provide the required level of service by either placing a single order large enough so he will never run out of stock, or else he may order as frequently as demands occur (provided lead time is no problem). However, in the real world of scarce resources, the Navy inventory manager must consider the cost and availability of storage space, the cost to place an order, the investment cost of material purchased and inventory obsolescence rates. The next section discusses the costs of inventory.

Costs of Inventory

The objective of inventory magement is to have the appropriate amounts of raw materials, supplies and finished goods in the right place, at the right time and at low cost. Inventory costs result from action or lack of action by management in establishing the inventory system. The costs of inventory that are important to the Navy include:

- The cost of the inventory management system itself.
- Holding cost.
- The value of the material held in inventory.
- Order costs (also called setup or replenishment cost). This is the fixed cost associated with a reorder.
- Shortage (also known as stockout) cost.
- In-transit holding (normally this cost does not figure in Navy cost computations).
- Transportation cost.

Both the intuitive and the mathematical approaches to modern inventory control systems seek to balance, and thereby minimize the total annual costs of operations. The

total cost equation can be generally described as:

Annual cost of buying the parts
+ Annual cost of ordering the parts
+ Annual cost of storing (holding) the parts
+ Annual cost of shortages
TOTAL ANNUAL COSTS

The ordering, holding and shortage costs are referred to as variable costs, because they vary with the operating doctrine and management's approach to inventory policy. DOD instructions provide definitions of these costs for military inventory models at the wholesale level:

1. **Order Costs** - DOD Instruction 4140.39 defines the cost components that the Services may include in this element. These primarily consist of the salaries of personnel involved in inventory control and contracting, plus supplies and data processing costs used to determine and process buys, plus the stock point's receipt and stowage costs.[1]

2. **Holding Costs** - DOD Instruction 4140.39 also describes the elements of holding costs to be used by the Services. An investment or opportunity cost, the cost of losses due to obsolescence and other losses such as pilferage and storage costs are specific elements of holding cost. Holding costs are computed using a holding cost rate (I) which is expressed as a percent per year of the on-hand inventory dollar value.

3. **Shortage or Backorder Costs** - Conceptually, shortage or backorder costs are the actual cost of not having an item available when the customer needs it. In the military environment it is extremely difficult (and politically infeasible) to obtain dollar values for the costs of shortage, as it may involve placing a dollar value on the loss of a life. DOD Instruction 4140.39 permits the military to use implied shortage costs as a management parameter based on the funds available for investment in inventories and in the management of these inventories.

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1 Most wholesale level stock in the Navy inventory is stored at various stock points, often in the same bin as the stock point's retail intermediate material.

For a majority of Navy applications, the cost to hold inventories constitutes a large portion of the inventory system expense. This cost is determined by assuming the annual holding cost rate, I, to be a percentage of the unit price of the item in inventory. The components of the annual holding cost rate are shown below for consumable and for repairable items.

For Consumable Items:

▪ Time value of money:	10%
▪ Warehousing:	1%
▪ Obsolescence:	10%
▪ Theft & Shrinkage:	2%
Total:	23% per year

For Repairable Items:

▪ Time value of money:	10%
▪ Warehousing:	1%
▪ Obsolescence:	10%
▪ Theft & Shrinkage:	0%
Total:	21% per year

The Basic Inventory Models: Continuous and Periodic

The two basic model structures that have evolved from considerations of costs, management control, and accounting practices are the continuous review and periodic review systems. The more realistic models evolve from these basic ones and will be explained in detail in later chapters.

Continuous Review Models

The first continuous review model presented here is called the Q-system. It can be used for consumable items and allows for uncertain demand and procurement leadtimes. In addition, backorders[2] are allowed and those demands associated with backorders will be filled as soon as stock becomes available from reorders placed by the inventory manager.

In this model we assume that the inventory position (on-hand plus on-order minus backorders) is monitored continuously using a transaction reporting system. This way the exact time to place an order (for more stock for the inventory) can be correctly determined. This exact time to reorder is identified by comparing the inventory position to a quantity called the reorder point. The reorder point is one of the two decision

2 Items are promised to one or more customers of the facility holding the inventory.

variables in the Q-system, and is given the symbol R. You will see variants of this symbol, such as R_2, in various sections of this publication.

Once the reorder point is determined in the Q-system, the amount to order when an order is placed is called the reorder quantity and is given the symbol, Q. It is the second of the two decision variables used in the Q-system. In the Navy supply system, the size of the reorder quantity is based on some form of the economic order quantity (EOQ) formula. The reorder quantity will remain the same for each reorder cycle, provided the forecasted demand and item cost remain constant.

In order to find the appropriate values for Q and R, we must define a measure of effectiveness by which to judge our choice of values. The measure of effectiveness used by the Navy at the wholesale level is the total annual variable operating cost. In other words, we find the values of Q and R that balance annualized ordering, holding and backorder costs. The Navy's wholesale models also subject Q and R to various constraints related to shelf life, manpower limitations, stockout probabilities, life-of-type conditions and other conditions. At this time, however, we will postpone discussion of these constraints until Chapter 3. This way, we can concentrate on the basic ideas involved with balancing ordering, holding and backorder costs.

Another type of continuous review system is the min-max system. This is the type of inventory control system which the Navy actually uses at the wholesale level. The decision variables used in the min-max system are the same as the decision variables used in the Q-system.

In the min-max system, a replenishment order is triggered when the on-hand quantity reaches or falls below the reorder level, R. This differs from the Q-system in that the Q-system places a replenishment order when the inventory position *exactly* reaches R. When customers can requisition material in quantities larger than one unit, its possible for the next demand (requisition) to take the inventory position *below* R instantaneously. The Q-system of control isn't designed to deal with this, thus we have the min-max system. Under the min-max system, the replenishment quantity is increased (from Q) by the amount of the deficit between the reorder point quantity (R) and the inventory position at the time the order is placed. A side benefit of this process is that it gives the Navy an easy method for increasing the size of the replenishment order when there are pre-planned requirements for material in support of depot overhauls, ship reworks, and other preventive maintenance and modification work.

Graphically, the reorder level and the changes in on-hand inventory over time for a continuous review model with variable demand and lead time can be depicted as shown in Figure (13). This figure shows net inventory (on-hand - backorders) versus time.

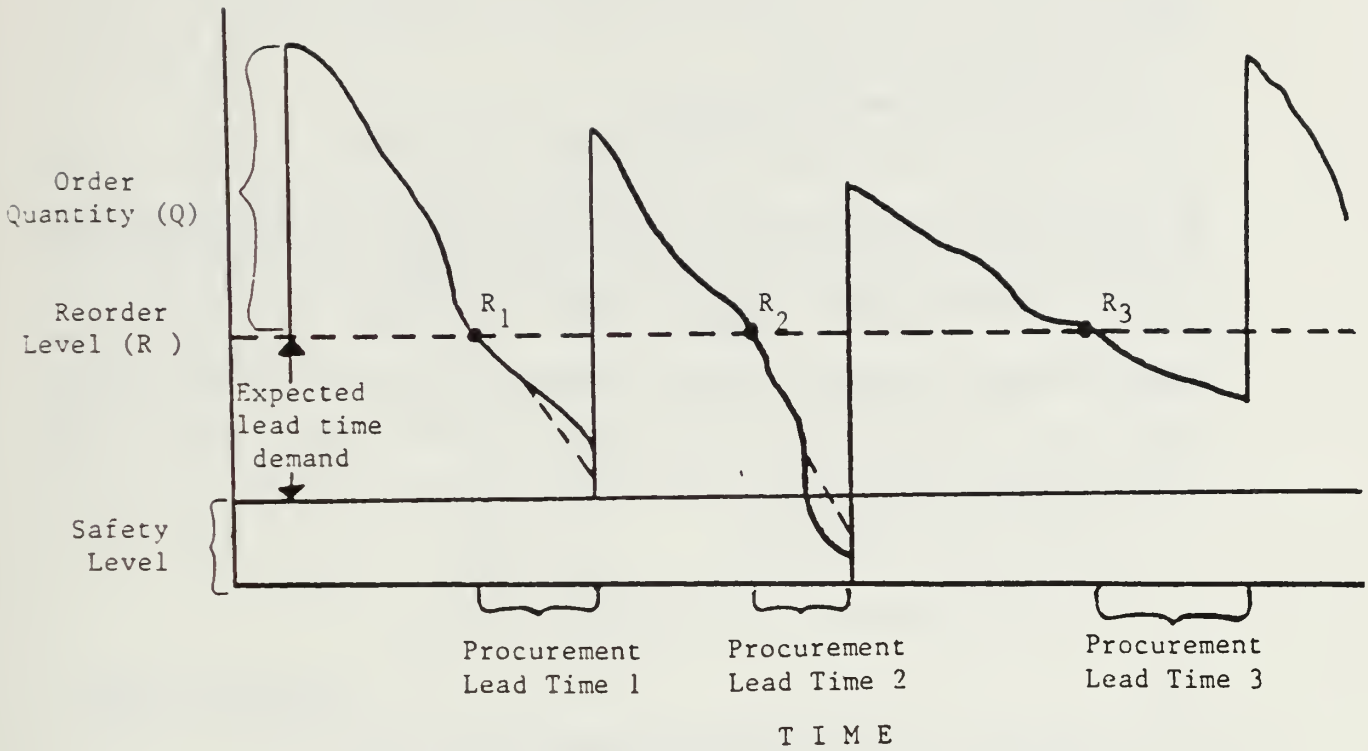

Figure 13. A Continuous Review Inventory System

Notice that the order quantity (Q) is the same for every order and the time between orders varies. In the simplest approach to this model, the optimal order quantity Q is that value which minimizes the ordering and holding costs. For a consumable item this results in:

$$Q = \sqrt{\frac{S.1D}{IC}}$$

where:

A = The administrative order cost

D = Average quarterly demand

I = The holding cost rate including consideration of investment cost, storage, obsolescence and losses

C = The replacement cost of the item

The Reorder Level (R) for a consumable is determined from minimizing the costs of carrying safety level and of incurring backorders. It is a function of leadtime demand and the variability of demand. The formula for R is:

$$R = (D \times L) + SL$$

where:
D = Average quarterly demand
L = The procurement lead time in quarters
SL = Safety level, a function of demand and lead time variability

The concept of risk or the probability of stockout provides a systematic basis for translating customer service requirements and economics into safety levels. The use of risk to establish safety levels will be discussed in depth in later chapters.

Example Problem: Suppose you manage a consumable item with the characteristics shown below. Here's how you would use the EOQ formula, without additional constraints, to compute the order quantity and reorder point.

```
D = 20 units per quarter        A = $150
I = .23                         C = $285
L = 4.8 quarters               SL = 4 units
```

Then:

$$Q = \sqrt{\frac{(8)(20)(150)}{(.23)(285)}} = 19.13$$

Q is usually rounded up, in this case, to 20.

Next:

$$R = (20)(4.8) + 4 = 100$$

A more comprehensive description of the consumable model and the extensions needed to handle repairable items are provided in Chapter 3.

Periodic Review Models

The periodic review system is based on a policy of reviewing and ordering at fixed regular intervals. One type of periodic review system is referred to as the P-system. In this control system, the inventory position is checked at the end of every T time units. If the inventory position is found to be below a level called the requisitioning objective (RO), then an order is placed which is large enough to bring the inventory position back up to the level of the RO. Note that the actual quantity purchased will vary from order to order.

In the P-system, the two decision variables are our choice of value for T, the review interval, and for RO, the requisitioning objective. Because orders are placed at predeter-

mined intervals without examining the stock position at times between orders, the value of *RO* should be set equal to the expected demand between reorders, plus some allowance for the variability of demand. Higher levels of inventory are required under the P-system than for continuous review systems under similar demand rates and procurement lead times.

There is another type of periodic review system that combines the features of the min-max and P-systems. It is called the T.R.RO system. In this system the inventory level is reviewed every T units of time to see if the inventory position has dropped below the reorder point (*R*, the same type of reorder point as is used in the min-max system). If so, a replenishment order is placed which will bring the inventory position up to the level of the requisitioning objective, *RO* . Under the T.R.RO system there are three decision variables: the review interval, *T*; the reorder point, *R*; and the requisitioning objective, *RO*.

Figure (14) is a graph of net inventory over time for an inventory managed under the P-system of inventory control.

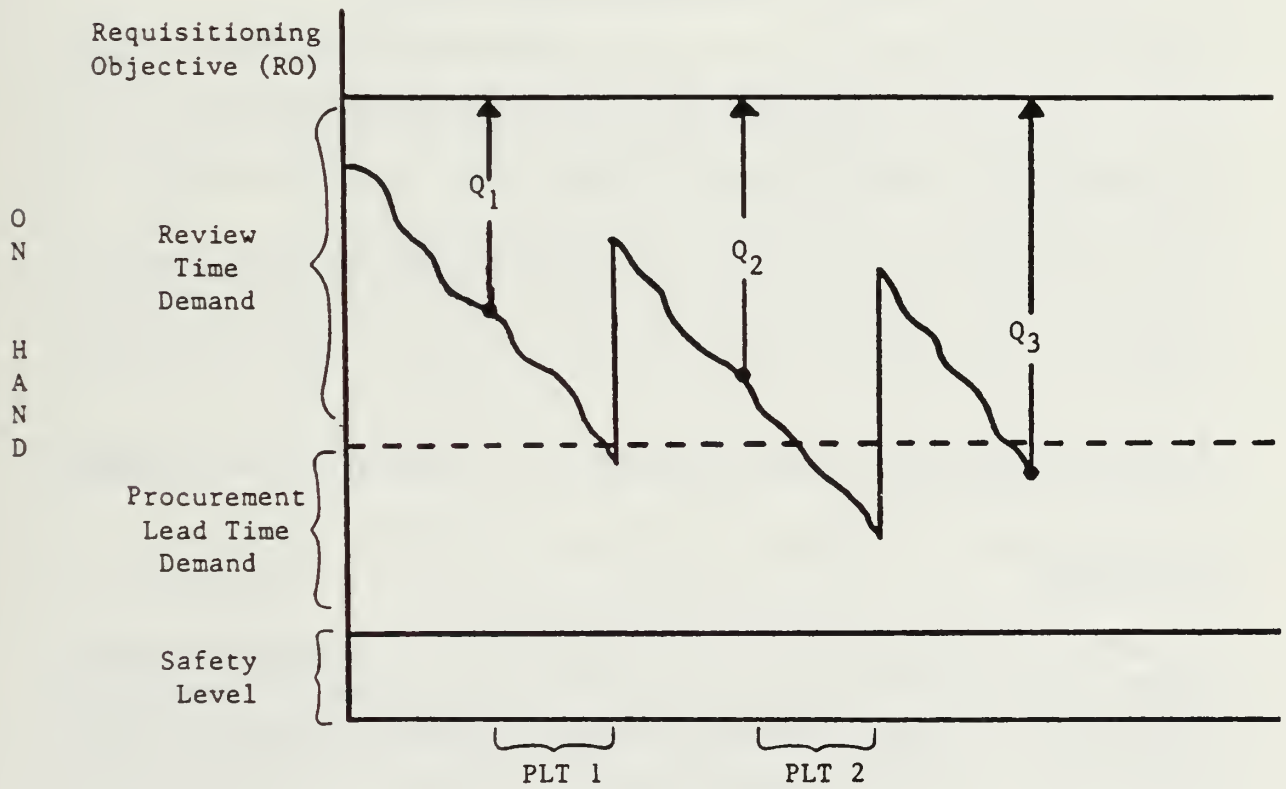

Figure 14. A Periodic Review Inventory System

The target requisitioning objective (*RO*) must include at least the sum of the expected demand during one procurement lead time, plus one review time, plus safety level, if any. Order quantities are simply the difference between the RO and the on-hand inventory at the time of the review. Although a higher investment level is required for this type of system, the additional costs are partially offset by lower clerical and data processing costs obtained by performing only periodic reviews of the inventory system. A periodic review system may be the most economical system for inexpensive items, when review and processing costs are high, and item investment and storage costs are low, or when the cost of operating a continuous review system is prohibitive. The requisitioning objective (*RO*) for the periodic review (P-system) model is defined as:

$$RO = (D \times L) + (D \times T) + SL$$

where:
D = Average quarterly demand
L = Procurement leadtime in quarters
T = The length of the review period in quarters
SL = Safety level, a function of demand and leadtime variability

Although the mathematical models for periodic review control processes are infrequently used in Navy inventory applications, they are presented for comparison and contrast with the continuous review model. In reality, periodic review is used by SPCC and ASO when they review stock levels during a process called supply demand review (SDR). The SDR program is run on a periodic basis (typically twice a month, i.e. T = 2 weeks). If the reorder point has been passed, then they order Q plus whatever deficit exists below the reorder point, i.e. they order up to *RO*. This is the T,R,RO system of inventory control.[3]

PERFORMANCE MEASURES OF EFFECTIVENESS

Introduction

Measurements for guaging how well the supply and inventory system performs, and how reliably a weapon system performs provide feedback to the requirements determination process at both the program support ICP and at the retail level. The measure of effectiveness (MOE) is used to judge the decision maker's choices of values for the decision

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3 However, ASO and SPCC use the mathematical model associated with the min-max system of inventory control, since the SDR program is run fairly frequently. (The original intention was to run the SDR program at the end of every day. This was never done because of limitations inherent in the computer hardware at ASO and SPCC. Also, postponing the running of the SDR program is sometimes used to postpone the expenditure of funds.)

variables. Finding the appropriate measure of effectiveness (MOE) has always been a difficult problem because as we define MOEs which better represent our ultimate objectives, the amount and type of data required to compute the MOE increases, the mathematics involved becomes more difficult, and the cost of obtaining the measurement increases. All MOE's fall into three basic categories:

- Cost type MOEs.
- MOEs which give an indication of how well the supply system is providing material to the customer.
- Miscellaneous MOEs.

Unfortunately, these various inventory system MOE categories have numerous tradeoffs, i.e. as we make changes in the decision variables to obtain an improvement in one MOE, another MOE may worsen. The most significant conflict is the one between MOEs which represent cost (which we wish to minimize) and the MOEs which represent customer service (which we wish to maximize). In the ever competitive environment for scarce budget resources, the latest development has been to measure effectiveness by attempting to directly match resources to readiness.

This following section will discuss the:

1. MOEs actually in current use by Navy decision makers.
2. MOEs which will be or may be used by Navy decision makers in the future.

Current Measures of Effectiveness

Many MOEs are in use today by all inventory levels in the supply system. Some of the major MOEs include the following:

Total Costs

This is the total cost of holding, of ordering and of shortages. It is typically measured on an annual basis.

Specific Cost Measures

These MOEs monitor expenditures in specific cost areas such as:

- Research, testing, development and evaluation (RDT&E).
- Operations and maintenance (O&M).
- Other procurement - Navy (OPN).
- Transportation.
- Navy stock fund (NSF).

- Appropriated purchases account (APA).

System Material Availability (SMA)

SMA, a customer service measure for the wholesale level, is defined as the percent of requisitions which are satisfied on the first pass against system assets and is prepared monthly by a Uniformed Inventory Control Point (UICP) program known as M67. It is computed as follows:

$$SMA(\%) = 100 \times \left[1.0 - \frac{\text{Backorders Established + DVDs Established}}{\text{Demand}} \right]$$

or, alternatively as:

$$SMA(\%) = 100 \times \left[1.0 - \frac{\text{MOE}}{\text{Demand}} \right]$$

where:

DVD = Direct Vendor Deliveries

MOE = Material Obligations Established = Backorders + DVDs

The current Navy goal for wholesale SMA is 85 percent.

Gross Effectiveness

This MOE is the percent of total requisitions, for both stocked and non-stocked items, received and satisfied from stock on-hand at any given echelon of inventory. Gross effectiveness is mainly used by the stock points and the retail consumer level supply departments as a measure of customer service.

Net Effectiveness

This MOE is the percent of total requisitions, for stocked items, received and satisfied from stock on-hand. Again, the stock points and retail consumer levels use this as a measure of customer service.

Miscellaneous Measures of Effectiveness

Some miscellaneous MOEs used by supply system decision makers include the following:

- Measures of contract competition and breakout.
- Average days to stow receipts at a stock point.
- Warehouse refusal rate at a stock point.

- Effectiveness rates by material cognizance group.
- Inventory accuracy audit results.
- Transportation times.
- Procurement action lead times (contract order times).
- Material obligations outstanding.

There are, of course, many other MOEs, but those listed above provide an idea of the various supply system variables that must be measured.

Measures of Effectiveness for the Future

This section describes some MOEs that will be applied to evaluate the supply system in the future. The following MOEs are in some stage of development or use by the supply system:

Operational Availability (A_o)

The supply system is but one key input to our military readiness posture. A_o is the official Navy measure of weapon system performance. It is a measure of readiness and as such provides an indicator of hardware, fleet and total supply system performance. A_o is not measured on a regular basis for all weapon systems but can be estimated as required from Casualty Reports (CASREPS) or reports on not mission capable-supply (NMCS) partially mission capable supply (PMCS) and maintenance and material management (3M) data. A_o is the probability that a system or equipment, when used under stated conditions in an actual operational environment, will operate satisfactorily when called upon [Blanchard, p. 65]. In concept the formula for A_o is:

$$A_o = \frac{UPTIME}{UPTIME + DOWNTIME}$$

In Navy use the formula for A_o is

$$A_o = \frac{MTBF}{MTBF + MTTR + MSRT}$$

where:
MTBF = Mean time between failures;
MTTR = Mean time to repair;
MSRT = Mean supply response time.

Operational availability is used to assist in the weapon system and major end item design process. It is also used in the creation of a few shipboard allowance lists. Eventually, A_o may be incorporated in some inventory requirements determination models.

Mean Supply Response Time (MSRT)

From the operational availability formula it is simple to observe that any reduction in the MSRT will increase A_o. MSRT will be used very soon for wholesale level provisioning and may be used in the more distant future for wholesale requirements determination. Chapters 2 and 4 further discuss A_o both as a performance measure and as a basis for inventory levels decisions.

Average Customer Wait Time (ACWT)

ACWT is a primary performance measure linking supply responsiveness to operational requirements. It is an MOE required by the DOD Retail Inventory Management and Stockage Policy (RIMSTOP). However, it isn't measured or used as such because there is no Navy-wide system available to obtain the data necessary to measure ACWT. Despite this fact, target goals have been established for ACWT. There are different goals for each issue priority group (IPG), and for CONUS and EXCONUS situations.

ACWT represents the average time required in the supply system to satisfy maintenance related demands, regardless of whether the demand was for a stocked or non-stocked item. ACWT is the collective goal for supply system response time for all customer demands, as measured from requisition generation until receipt of the material by the customer, including requisition submission and receipt take-up times. ACWT is ultimately expressed in hours. It depends on other performance measures (i.e., requisition processing times, gross availability at retail and wholsale levels and required transportation times). Shortfalls in availability at one echelon of supply may be compensated for by higher availability in another echelon.

The primary objective of the Navy supply system is to provide timely supply support to Navy operating forces and Naval activities. For example, the current average customer wait time goal for continental U.S. customers is 125 hours for items in issue priority groups I and II.[4] A shorter ACWT goal may be assigned for items which are part of a specific system or equipment if such assignment is required to support a higher readiness requirement specified by the Chief of Naval Operations (CNO). The achievement of the 125 hour ACWT goal is an integration of goals for requisition processing time, gross availability at the consumer level of inventory, gross availability at the intermediate level of inventory, gross availability at the wholesale level of inventory and transportation times. The goals for these variables are shown in Figure (15).

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4 IPG I and II requisitions are the most critical material requisitions.

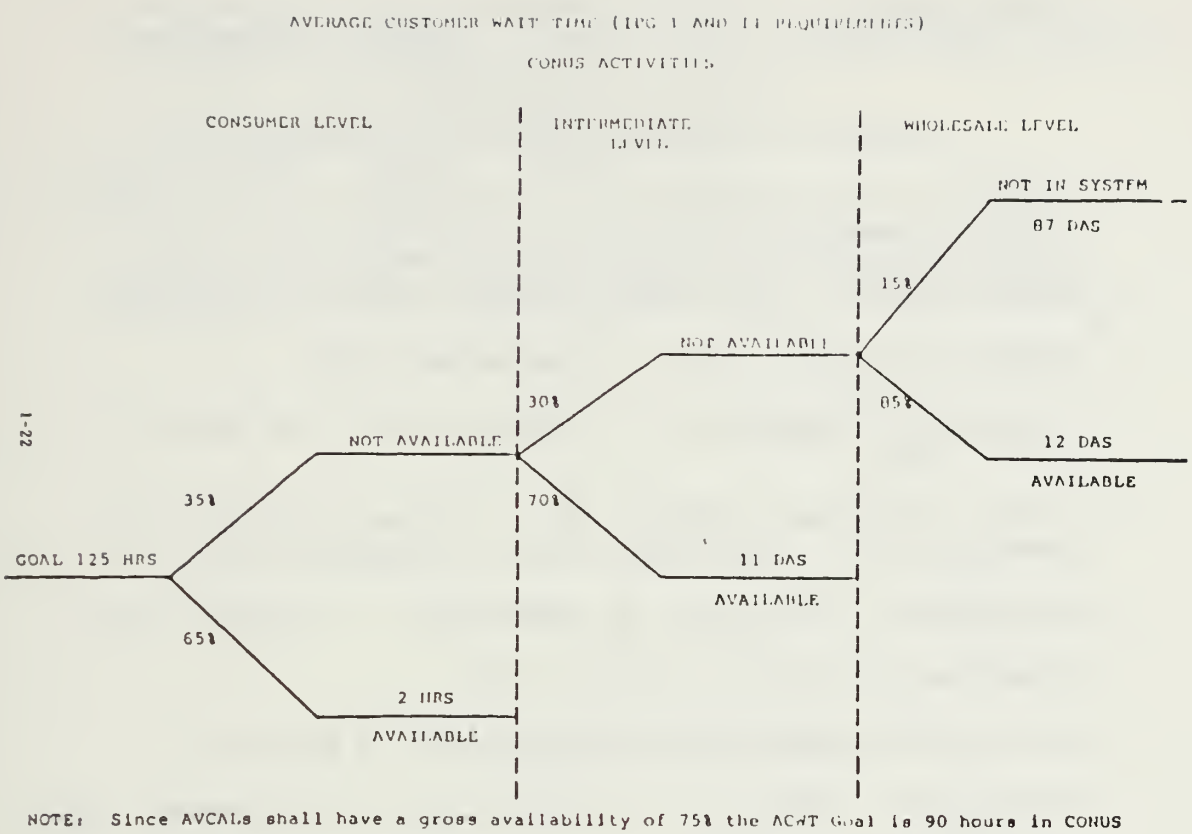

Figure 15. Average Customer Wait Time (IPG I and II requirements): Source - OPNAVINST 4441.12B.

SUMMARY

This chapter has provided an overview of the organization, decision variables, performance measures, and control processes used by the Navy in the management of its inventories. In order to understand the Navy's complex inventory management system, you must begin with the basic information provided in this introductory chapter. The following chapters will provide substantially more depth and detail about this complex system of interacting and competing goals.

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